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TANZANIA POST-COLONIAL EDUCATIONAL SYSTEM AND PERSPECTIVES ON SECONDARY SCIENCE EDUCATION, PEDAGOGY, AND CURRICULUM: A QUALITATIVE STUDY

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ABSTRACT

The development of technology and innovation in any country depends on a strong investment in science education from the lower to the upper levels of education. In most of the Sub-Saharan African nations, science education curriculum and teaching still faces many issues and problems that are inhibiting the growth of technology and innovation in these nations. In order to address these issues, an interpretive qualitative study that aims to examine how Tanzanian secondary science educators perceive secondary science education was conducted in the summer of 2013. The purpose of this study is to investigate problems and educational issues that might be limiting the growth of science, technology, and innovation in the Tanzanian society. Additionally, this research investigates the impacts of the colonial legacy that relates to language, politics, and economics, as they affect science education in Tanzania secondary schools. This study focuses on the governmental four-year ordinary level secondary science education; it took place in Dar-es-Salaam, Tanzania. The researcher interviewed nine secondary science educators: three secondary science teachers and six secondary science education administrators. The researcher also conducted classroom observations. The data results from both interview and classroom observations were contextualized with data from existing documentation on Tanzanian secondary science education and data from previous research. The emergent themes from the study indicate that most of the problems and issues that are currently facing secondary science education are historically connected to the impact of the colonization period in 19th and 20th centuries. This study suggests that in order to improve science education in Tanzanian society, the people, especially

the elites, need to break away from an “Orientalist” mindset and start integrating the Tanzanian culture and science into the still existing Eurocentric science curriculum. In addition, the Tanzanian government needs to invest in industries and economic initiatives that will support strong science education at all levels of education, as well as the graduates produced through this system.

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CHAPTER 1

Introduction

In this 21th Century, science, technology, and innovation have emerged as key drivers of economic growth globally. The discoveries of computer and information technology, as well as communication, have transformed people's way living and working (Darling-Hammond, 2010). Although current technology and innovation seem to be highly developed, scientists are continuing to investigate, to experiment, and to seek answers on some difficult questions surrounding the world we live in (White & Frederiksen, 1998). In addition, pre-college students in developed nations such as the U.S., most European countries, and Asian countries such as South Korea, Japan, China, and Singapore are learning science by observing, questioning, investigating, and experimenting, so that they can discover new knowledge about the world around them (Choi & Ramsey, 2009; Darling-Hammond, 2010). That type of pedagogical approach has not yet reached some poor nations like Tanzania, where children are learning science by memorizing science theories and figures as fixed facts of truth (O-saki, 2007; Semali & Mehta, 2012).

Studies show that teaching and learning science in Tanzanian secondary schools mostly focuses on passing national examination so that students can join some careers that require scientific knowledge (Semali & Mehta, 2013; Vavrus & Bartlett, 2013). In other words, gaining access to careers like medicine and engineering have been the major focus for studying science in Tanzanian secondary schools. Consequently, the development of science, technology, and innovation in Tanzania has lagged behind when compared to other nations such as the United

States and most countries in Europe and Asia. Despite the fact that college students in Tanzanian universities learn science, science literacy and innovation are still low when compared to some former colonized nations, such as India (Monahan, 2012). Studies show that about 87 percent of the Tanzanian population living in rural areas has no access to safe water, health clinics, and reliable communication (Mush, 2009; National Strategy for Growth and Reduction of Poverty, 2005).

In addition to these issues, the provision of science education in Tanzanian secondary schools has complex issues. These are related to training policies that are embedded in the legacy of the colonial educational system. Literature on the colonial education system legacy in Sub-Saharan African nations reveals that the introduction of Western forms of education in these African nations has destroyed the African educational philosophy (Mosha, 2000; Ngungi wa Thiong'o, 1994). Both Mosha and Ngungi wa Thiong'o argue that African educational philosophy emphasized the holistic. The African Philosophy always emphasized educating the whole person including mind, body, spirit, and relationship between the individual and the surrounding environment. On the contrary, colonial education has focused on mind only (Mosha, 2000; Ngungi wa Thiong'o, 1994).

Mosha (2000) also describes that the colonial educational system was Eurocentric. The school curriculum in both social science and natural/physical science subjects represented European culture, and it was taught in European languages. In the case of Tanzania, the English language was used as a language of instruction in all levels of education. Therefore, very little of the African literature, science, culture, or language was taught in schools (Mosha, 2000). Other scholars

such as O-saki (2005) and Mushi (2009) describe that after gaining independence from the colonizers, most of the Sub-Saharan nations tried to decolonize some of the colonial educational policies; however, some of the policies were immune to change. For example, in Tanzania, the educational decolonization in the late1960s and early 1970s focused on equal opportunity for education as well as a Tanzanian cultural emphasis in primary education (Mushi, 2009). The curriculum for primary school also used the national language, which is Kiswahili (Mushi, 2009).

In addition, the social science curriculum for the four junior secondary schools was decolonized. Social science subjects such as geography, history, and literature covered topics related to Tanzania and African culture and environment, but English language was maintained as a language of instruction in these schools (MoEVT, 2010; Mushi, 2009). Despite that educational decolonization process, the physical and the natural science curricula for secondary school were not changed (O-saki, 2005, 2007). Not only did the curricula continue to be Eurocentric, but also the teaching approach remained that of memorizing science facts rather than of understanding the scientific concepts (O-saki, 2007).

The introduction of the colonial science education in secondary schools has also been criticized for its policy, which is focused on training a labor force needed in the colonial industries. Scholars such Mosha (2000), Nieuwenhuis (1996), Brown (1971), and Peter and Venkatesan (2010) argue that the basic science that was taught to indigenous students aimed to produce the workforce that was needed in manufacturing processing industries and not any other industries. Therefore, the science curriculum contents reflected the Western economic power of the colonial

period. Thus, the curricula were founded on industrial revolution ideologies that focused on agriculture, mining, manufacturing, and transportation literacy.

Unfortunately, in Tanzania, the German and British colonizers did not establish or develop any local sophisticated industries that needed scientific expertise. For any advanced scientific process, the raw materials were shifted to Europe to refine and to develop (Peter & Venkatesan, 2010). These training policies later caused some negative impacts in the Tanzanian science education system, as will be elaborated in more detail in chapter 5.

The aim of this research is to understand how the educational past remains within the current science education in Tanzanian secondary schools. This research will reveal the implications and challenges in the Tanzanian government-sponsored, ordinary-level secondary school (O-level) setting. The research focuses on the governmental four-year level secondary schools. The main focus is on problematic issues that might limit both boys and girls from persuing science in post-secondary education. Further, the researcher is interested in learning how science teachers and administrators experience the Tanzanian secondary science education. Additionally, this research investigates the colonial power related to language, politics, and economics, as they affect the science education in Tanzanian secondary schools.

Rationale for Study

First of all, scholarship and research on the topic of the impacts of colonial education on science education in Sub-Saharan African nations is limited. Most of the available literature compares the differences between the African pre-colonial

era educational systems and the colonial period education system. A few researchers have investigated the development and provision of education in the post-colonial period, but they did not examine these implications specifically in the science education area. For instance, Osei (2009), in his research on the provision of education in Ghana, focused on school culture, bureaucracy, and teachers in terms of teachers' living condition and salary. Specifically, he looked at the issues of teachers' socioeconomic conditions and how teachers' living condition reflected their classroom practices.

Nieuwenhuis (1996) also investigated educational policy development and implementation in the post-colonial era in eight sub-Saharan African countries that were under British colonial rule. His research was conducted in Tanzania, Kenya, Zambia, Malawi, Lesotho, Swaziland, Botswana, and Zimbabwe. His research included the issues of school funding, the number of schools from K-14 and colleges in each country, graduate and school dropout rates for both male and female students, and unemployment conditions.

Mosha's (2000) research compares the colonial form of education and the holistic indigenous African education system. He describes how the indigenous system of education considered the entire person, including body, mind, and spirit, which is different from the colonial system of education, in which mind is given preference over other aspects. His research describes how science is not separated from spiritual life. He recognizes the power of science that indigenous African education includes, but he did not discuss how this might have influence on Tanzanian secondary education.

Pandy and Moorad's (2003) article talks about the decolonization of curriculum in Botswana. Their work describes how the colonial form of education has impacted Botswana citizens' social life by creating social classes among the indigenous population. They proposed a new form of school curriculum that might emphasize human dignity, equality, and social justice for individuals who have been oppressed by the education system. Their work mostly focuses on school curriculum in general and not specifically on post-colonial secondary science curriculum.

A body of scholarship that presents a critical educational perspective of post-colonial Africa is that of Ngungi wa Thiong'o, a Kenyan literature scholar who has been advocating the importance of writing literature in indigenous languages (Ngungi wa Thiong'o, 1994). Although his arguments are not directly about the provision of science education, his point of view on language and culture provides a different perspective from the regular interpretation of the relationship of language, culture, and education. Ngungi wa Thiong'o (1994) states:

> Language is not a mere string of words. It has a suggestive power well beyond the immediate and lexical meaning. However, any language has a dual character. It has both a means of communication and a carrier of culture and history. The second aspect of language as a culture is an image-forming agent in the mind of a child. For example, a whole conception of ourselves as a people, individually and collectively is based on those pictures and images that may or may not correctly correspond to the actual reality of the struggle with nature and nurture that produce in the first place. But our capacity to confront the world creatively is dependent on how those images correspond

> or not to that reality; how they distort or clarify the reality of our struggle. (p. 441)

He also argues that learning in an unfamiliar language does not help the learner to connect to reality because that language has other people's culture and meaning. His hypothesis is that science and technology have not developed well in Sub-Saharan African countries because students learn science in a language not familiar to them (Ngungi wa Thiong'o, 1994).

The problem of the language of instruction in schools, especially in the Tanzania secondary education setting, cannot be denied. This is because the English language is not emphasized in the public primary education setting, and it is not spoken on a regular basis. Therefore, teaching or learning science in English is problematic not only for students, but also for teachers. Research from the Ministry of Education indicates that most teachers who are graduating from teacher colleges and who are teaching in the four-year secondary public schools experience English language difficulties (MOEC, 2001). As will be demonstrated later, this is one of the challenges for the provision of quality science education in the Tanzanian government secondary schools.

In addition, Birgit Brock-Utne, a professor of education and development at the University of Oslo, Norway, has conducted several research projects related to language, culture, and science education in Tanzania and South Africa. In 2007, Brock-Utne conducted an experiment in one of the Tanzanian secondary schools. Her study was to compare students' learning outcomes between studying science subjects in Kiswahili language and in English language. The study's findings show

that when students learn science in Kiswahili they are eager to participate and share their previous knowledge and experience. When the same topics were taught in English, they tend to keep silent, and they do not participate (Brock-Utne, 2007). Brock-Utne's research findings will further described in chapter 4.

There is little research invested in current perceptions of and attitudes toward science education at the Tanzanian institutional level. This current study aims to learn about the present perceptions, beliefs, and attitudes toward science education held by both educators and administrators. The participants in this study included three secondary science teachers, two administrators from the Tanzanian Institute of Education (TIE), two administrators from the National Examination Council of Tanzania (NECTA), and two administrators from the Ministry of Education and Vocational Training (MoEVT). All nine participants have firsthand experience of secondary science education. They also know the challenges and struggles experienced on a day-to-day basis as they work toward improving the secondary educational setting.

Moreover, this study is also in line with the long-term Tanzanian development plan (the 2025 Development Vision). The 2025 Vision calls for restructuring the educational system qualitatively in order to promote creativity and problem solving (MOEC, 2002). The desire to reexamine science education in Tanzanian governmental secondary schools exists for three reasons: (i) the consistency of students' poor performance in science subjects; (ii) the decreasing number of students joining post-secondary science education; and (iii) the lack of science research investigation at the secondary educational level (MOEC, 2002). In

order to gain rich information from individuals' lived experiences, the researcher in this current study uses a qualitative method as an approach for data collection and analysis. The three sources of data collected include interviews, classroom observations, and documents, such as secondary science syllabi and past examination papers.

Research Questions

In order to have a broader picture of the secondary science education at the Tanzanian institutional level, this study addresses the following three questions:

1. How is secondary science education perceived by science teachers and administrators from the MoEVT, TIE, and NECTA?
2. Do their attitudes and beliefs reflect the science curriculum and how science is practiced in classrooms?
3. To what extent does the legacy of colonial education and a Eurocentric mindset play a role in how secondary science education is provided?

Location and Climate of Tanzania

Tanzania is located in Eastern Africa between longitude 29^0 and 41^0 East and latitude 1^0 and 12^0 South. Tanzania is surrounded by Kenya and Uganda to the North; Rwanda, Burundi, and the Democratic Republic of the Congo to the West; Zambia, Malawi, and Mozambique to the South; and the Indian Ocean to the East. Tanzania has a tropical climate: temperatures range between 10^0c and 20^0c, which is equivalent to 60^0f and 80^0f, during the cold and hot seasons. The name Tanzania

resulted from uniting two countries, Tanganyika and Zanzibar. The two countries united in 1964 to form the United Republic of Tanzania (O-saki, 2007).

Land Coverage, Population, and Economy

Tanzania has a surface area of 364,898 square miles (945,087 square kilometers), with an estimated population of 45 million according to the Tanzanian 2012 census (National Statistical Office of Tanzania). About 40-45% of the population practice Christianity, and 30-40% practice Islam (Mushi, 2009). The major language of communication is Kiswahili. After independence in 1961, Tanzania was under a single political party that emphasized a socialist form of society until 1995, when the country adapted the multiparty political system (Mushi, 2009). Tanzania has dozens of beautiful national parks, including Serengeti National Park, the Ngorongoro Conservation Area, Mount Kilimanjaro, eight other mountains, 13 game reserves, 38 game-controlled areas, 120 cultural heritage sites, Lake Victoria, Lake Tanganyika, Lake Nyasa, and other small lakes. In addition, Tanzania has vast amounts of natural resources, including gold, natural gas, diamonds, tanzanite, coal, iron ore, uranium, nickel, tin, platinum, and other minerals. Tanzania is the third-largest producer of gold in Africa after South Africa and Ghana. Despite having these great natural resources, the Tanzanian economy is still mostly based on agriculture, which accounts for more than half of the GDP, provides approximately 85 percent of exports, and employs approximately 80 percent of the work force. The major exported crops are coffee, cotton, cashewnut, tobacco, sisal, pyrethrum, tea, cloves, fruits crops, oil seeds, spices, and flowers (Mushi, 2009).

Tanzanian Educational Background

Tanzania as a nation realizes that quality education is the pillar of national development, for it is through education that the nation obtains skilled manpower to serve in various sectors of the nation's economy. According to a report from the Ministry of Education and Culture (2005), Tanzanian education is based on seven major objectives as described in the next section of this research. Additionally, the Tanzanian educational system uses one national curriculum in both public and private schools. The structure of the Formal Education and Training System in Tanzania also constitutes two years of pre-primary education, seven years of primary education, four years of Junior Secondary (Ordinary Level), two years of Senior Secondary (Advanced Level), and up to three or more years of Tertiary Education. Specifically, the educational system has three levels: Basic, Secondary, and Tertiary. The MoEVT department is responsible for creating, monitoring, and improving the educational system. The TIE department is an institute responsible for developing curriculum for Primary, Secondary, and Teacher Education, and the NECTA department is responsible for preparing national examinations for primary, secondary, and teacher colleges (O-saki, 2007; TIE, 2012).

General Objectives of Education in Tanzania

In general, Tanzania, like other developing countries, recognizes the importance of providing quality education to its people through specific objectives based on the society's cultural practices. The following paragraph is a list of the Tanzanian current science objectives taken from the new biology syllabus. The objectives are addressed as follows:

> The general aims and objectives of education in Tanzania are to: (a) to guide and promote the development and improvement of the personalities of citizens of Tanzania, their human resources and effective utilization of those resources in bringing about individual and national development; (b) to promote the acquisition and appreciation of the culture, customs, and traditions of the people of Tanzania; (c) to promote the acquisition and appropriate use of literacy, social, scientific, vocational, technological, professional and other forms of knowledge, skills and attitudes for the development and improvement of the condition of man and society; (d) to develop and promote self-confidence and an inquiring mind understanding and respect for human dignity, human rights and readiness to work hard for self-advancement and national development; (e) to promote and expand the scope of acquisition, improvement and upgrading of mental, practical, productive, and other skills needed to meet the changing needs of industry and economy; (f) to enable every citizen to understand and uphold the fundamentals of the National Constitution as well as the enshrined human and civil rights, obligations and responsibilities; and (g) to promote love for work, self-employment and wage employment and improvement of performance in the production and service sectors. (MOEC, 2005, p. iv)

These objectives present the general purpose of the Tanzanian educational system and acquisitions for all education levels, and they will be further described in the following chapters.

Language of Instruction

Tanzania is a multilingual nation. There are over 127 dialects that are spoken within the country, but the majority of the population speaks Kiswahili as their second language, and it is used for cross-tribal communication (Gordon, 2005). It is estimated that that 99 percent of Tanzanians speak Kiswahili and the majority of the young generation consider Kiswahili as their first language (Brock-Utne, 2005). In short, Kiswahili is a Bantu language in structure and vocabulary, and it is closely related to the majority of the local dialects. Some of the Kiswahili vocabularies are Arabic due to the influences of the pre-colonial trade, which was conducted by local Tanzanians and the Middle East nations on the coast of the Indian Ocean (Mushi, 2009). Studies show that during the German colonial rule of Tanzania, Kiswahili was used as language of instruction in schools as well as in governmental administration. However, that practice was changed during the British colonial rule, which introduced English as a language of instruction in schools and in governmental administration (Mushi, 2009). When Tanzania gained its independence in 1961, Kiswahili was made an official national language and became a language of instruction for pre-secondary education, and English became a language of instruction for secondary education and in tertiary education settings (Mushi, 2009). The learning of Kiswahili enables Tanzania's students to keep in touch with their cultural values and heritage. In addition, Kiswahili is taught as a core academic subject in secondary schools, and it is a major subject at tertiary level for students interested in linguistic and literature studies. In general, English is not practically

used by the majority, but it is recognized as an essential language of communication that links Tanzania and the rest of the world (Mushi, 2009).

Theoretical Framework of this Research

This study adopts both post-colonial theory and scientific inquiry theory as approaches to analyzing the issue of power related to language, politics, and economics, as they affect science education in Tanzanian secondary schools. The scientific inquiry theory is used for two purposes: the implications of using English as a language of instruction and the effects of Eurocentric science curriculum in secondary schools. In addition, this theory is used as a tool to analyze the pedagogical struggles of teaching and learning science in schools that have limited resources, unqualified science teachers, and inadequate school facilities. Post-colonial theory is used to analyze the historical complexity of the colonial economic and political structures that influence the current Tanzanian educational system.

What is Post-colonial Theory?

Post-colonial theory is one of the critical theories used by qualitative researchers. This theory is an approach to analyze or critique the historical implications of the colonial legacy in the economy, politics, education, language, and culture of countries that have been colonized (Ahluwalia, 2001; Hall, 1996; Venn, 2006). Historically, post-colonial theory originated from Edward Said's *Orientalism*, which was published in 1978. The term "Orientalism" dates from the period of European colonization in the Middle East and South Asia. It specifically describes how the European Orientalists (i.e., artists, historians, and scholars) depicted or

painted both Arabic and Asian culture and traditions as different and inferior to Western culture (McCarthy, 1998). Said used the term Orientalism to describe how the West thinks of the East or the "Orient" (the term Orient in Said's description means the "Other"). According to Said, thinking of the "Other" through the lens of Orientalism usually distorts the reality of those people and also perpetuates stereotyping (Said, 1978).

Said (1978) also describes the danger of using Orientalism as the measure of facts or truth about the "Other" without an understanding of the historical complexity of those categories. He states:

> When one uses categories like Oriental and Western as both the starting and the end points of analysis, research, public policy (as the categories were used by Balfour and Cromer), the result is usually to polarize the distinction… the Oriental becomes more Oriental, the Westerner more Western… and limit the human encounter between different cultures, traditions, and societies. In short, from its earliest modern history to the present, Orientalism as a form of thought for dealing with the foreign has typically shown the altogether regrettable tendency of any knowledge based on such hard-and-fast distinctions as "East" and "West": to channel thought into a West or an East compartment. Because this tendency is right at the center of Orientalist theory, practice, and values found in the West, the sense of Western power over the Orient is taken for granted as having the status of scientific truth. (p.46)

Said's work on Orientalism became one of the foundational texts for the academic field of post-colonial studies in educational research and curriculum, particularly in shaping school environment (McCarthy 1998). Historically, schools have been critical sites of struggle for equal rights and democratic practices of past and present. Therefore, post-colonial studies that examine educational phenomena attempt to make visible the issues and struggles endured by schools, especially toward providing both equality and quality education (Subedi & Lynn Daza, 2008).

There are several educational research projects that have used post-colonial theory to examine the education and colonial experience issues, such as identity, politics, economics, race, and culture of the former colonized nations (Altbach & Kelly, 1984). In this present study, the researcher uses David Kopf's (1969) work as a reflection for data analysis. Kopf's work is about the impact of the British Orientalists on the current Indian education, culture, economics, language, politics, and religions. Kopf describes that between 1772 and 1830 British Orientalists (i.e., scholarly officials and missionaries) who were able to communicate in South Asian languages and who were associated with the colonial government started conducting research in India. Their studies included history, archaeology, language, and religions, including Hinduism, Islam, and Buddhism. In addition, they founded "the modern Asian Society in Calcutta," and they introduced bookstores, libraries, publishing houses, and colleges (Kopf).

Kopf (1969) argues that although those Orientalists were instrumental in stabilizing the British role in India, their major role was to modernize the Indian tradition and culture. Therefore, indigenous people who collaborated with the

British Orientalists became Orientalists themselves by combining their culture and tradition with modern value from the contemporary West. In that way, the local Orientalists together with the British Orientalists have influenced contemporary Indian economics, society, politics, and education (Kopf, 1969). In this study, the researcher analyzes the implications and the historical complexity of the colonial legacy in current Tanzanian science education, especially in governmental institutions. Also, the study analyzes the impacts and influences of external organizations (i.e., World Bank, UNESCO). It also focuses on local elites and politicians, as they influence Tanzania's educational, economic, and political systems.

What is Scientific Inquiry Theory?

Scientific inquiry theory is generally defined as a process of asking questions, generating data through observation or experimentation, interpreting data, and drawing conclusions (White & Frederiksen, 1998). The foundational aspects of scientific inquiry include the following: the knowledge and kind of questions that can be answered through inquiry; the kind of methods that are accepted within disciplines for generating data; and the standards for what counts as legitimate interpretations of data, including explanations, models, and theories. Placing these scientific practices in the foreground of inquiry helps students understand the natural world around them (Burnett, 2010; Etheredge & Al Rudnitsky, 2003; Schiro, 2008; Tobin, Tippins, & Gallard, 1994). Inquiry learning empowers students to discover what interests them and encourages them to use this skill to further their knowledge (Etheredge & Al Rudnitsky, 2003; Ramsey & Choi, 2009).

In general, scientific inquiry theory has been developed from a constructivist theoretical perspective. The main idea of this theory is that learning is a function of the interaction between people and their environment. For decades educational researchers, curriculum developers, teacher trainers, sociologists, philosophers, and other constructivists have used this theory to describe how individuals acquire knowledge from their surrounding environment (Philips, 2000; Schiro, 2008). Constructivist theory has its primary roots in the work of constructivists such as Lev Vygotsky, Jean Piaget, and John Dewey. Learners acquire knowledge either through interacting with experienced people or from the environment they encounter every day (Schiro, 2008). It states that people are not passive agents during their interaction with the environment, but rather are active agents of their own learning (Schiro, 2008; Tobin, 2000). Learning through inquiry is believed to be an important approach in which students are empowered by using combined processes such as scientific knowledge, scientific reasoning, and critical thinking (Ramsey & Choi, 2009).

The implementation of scientific inquiry theory as an approach to teaching and learning science at the secondary level has been popular in most parts of the world. However, Tanzanian secondary students, especially in government schools, are lagging behind (O-saki, 2005). As noted before, this study adopts scientific inquiry theory as a tool to analyze the pedagogical struggles of teaching and learning science in Tanzania schools. The focus will be on schools with limited funds, unqualified science teachers, and inadequate school resources. Also scientific inquiry theory is used to analyze the issue of power relations embedded in the

language of instruction as well as in the Eurocentric science curriculum currently utilized in Tanzanian secondary schools. Combining both post-colonial theory and scientific inquiry theory as analytic lenses for this study provides an understanding of the historical complexity of the Tanzanian educational system since the colonial era to the present time.

Organizational Structure

Chapter 1 provides an introduction to the issues and discusses the rationale for the study, its purpose, and its research questions. It also includes the location and climate of the study area, its population, language, politics, economy, education system, and theoretical frameworks. Chapter 2 presents the literature review and a comprehensive history of the Tanzanian educational system from the pre-colonial era to the present time. The literature review focuses on the purposes of each form of education, the way it is provided, and the themes that relate or differentiate these forms of education. Chapter 3 describes the research methodology procedures in terms of data collection and analysis, ethical issues, and research objectivity. Chapter 4 presents the participants' points of view on the legacy of the colonial educational system in current Tanzanian secondary educational settings. Chapter 5 discusses the influence of politics and economics in Tanzanian secondary education. This chapter also analyzes how the local elites and politicians, the international donor agencies, and Western economic power influence science education in Tanzanian governmental secondary schools. Chapter 6 explores the issues regarding Tanzanian secondary science curriculum, school facilities and resources, science teachers' working conditions, and science teachers'

professionalization/professionalism. Chapter 7 is about the study implications and recommendations for future research.

CHAPTER 2

Literature Review

This chapter presents a review of literature on the Tanzanian educational system. The literature review covers four major historical periods that include the Tanzanian educational system before colonialism, during colonialism, during the early years of Tanzanian independency, and at the present time. The literature also focuses on the purposes of each form of education, the way it is provided, and the themes that relate or differentiate these forms of education. Reexamining the educational system through all four major historical periods will provide an insight into why the secondary educational system is currently practiced the way it is and why there is perhaps a need for change.

Tanzanian Educational System before Colonialism

Before colonialism, education was conducted according to the structure of the society, which was tribally based. The emphasis was on good citizenship, life skills acquisition, and the value of local customs (MOEC, 1995; Mosha, 2000; O-saki, 2005). There was no national educational system, no classrooms, and no national exams. Every tribe or clan educated their youth according to their culture and social practice, and the education was passed on generation to generation (Mosha, 2000; Mushi, 2009). In most cases, Tanzanian indigenous culture shared a common educational philosophy. That means the educational system focused on understanding and finding harmony with nature through knowledge of plants, animals, soils, water, and the environment around communities (Mosha, 2000;

Ngugi wa Thiong'o, 1994). Also, adults and children learned to work together for the community's common good. Collaborative learning and hard work was emphasized to a great extent (Mosha, 2000; Ngugi wa Thiong'o, 1994).

It is also described by Settles (1996) that before the Berlin conference of 1884-1885 that portioned the African continent according to colonies, African people lived in small communities. These communities were identified in three categories, including communities ruled by chiefs, those ruled by kings, and those following an empire system. The empire systems were mostly prominent in Western Africa (Settles, 1996). All three groups had their own form of political and economic systems. Economically, they traded with other parts of the world through exchanged goods (Settles, 1996). For example, people of Tanzania exchanged iron products, spices, beads, and carvings with people from the Middle East, South Asia, and Portugal (Mushi, 2009; Wembah-Rashid, 1973).

Studies also show that between 3000 and 2500 BC, Africa had already developed an industry innovation in which individuals used smelting and forging theories to produce metal products like jewelry, agricultural tools, and weapons (Grieg, 1937; Peter & Child, 1985; Raid, 2005; Wembah-Rashid, 1973). The smelting theory was used to produce metal products that needed high temperatures to separate the metal from oxygen and other elements before a refinery process. This entire process involved a number of stages: extracting ore from the soil, heating the ore at high temperatures between 800°c– 1150°c , and refining the metal into a final product (Raid, 2005). Metal smelting and forging were not the only technologies that existed in Sub-Saharan Africa. Raid (2005) explains that African people also

used carving and ceramics to produce tools that were used for preserving, cooling, and cooking. They also used the process of extraction to produce dairy, grain, and medicinal products. However, Sub-Saharan African science, technology, innovation, and economic activities were interrupted during the African slave trade period from the 15th century to 19th century. This interruption continued during the colonial period from the late 19th century to the 20th century (Raid, 2005). During colonial rule, African science and technology was viewed as savage and uncivilized (Raid, 2005).

In reality, African scientific knowledge and technology was not so different from what the colonizers introduced. The only difference was that each group used different methods to attain their purposes and probably used different tools. For example, in most everyday activities African people used science such as applied chemistry to prepare medicine, food, agricultural products, and liquor. Even today, African people who value their traditional way of living still use the traditional methods in agriculture, medicine, and liquor production. Also, children acquire this scientific knowledge either from their parents, grandparents, or other members of their communities (Mosha, 2000). When these students go to formal schools, their prior knowledge is not integrated into the science curriculum. In other words, science that is learned in the classroom does not represent students' culture and their everyday life experiences. The challenges of learning science in a Eurocentric curriculum will be further discussed in chapters 4 and 6.

Tanzanian Educational System during Colonialism

Historical and documentary accounts show that the Western form of education was introduced in Tanzania by missionary organizations of different dominations in the 1860s. The major aim of that education was to introduce Christianity and a Western economic system. The missionaries also introduced cash crops, such as coffee and tea (Mosha, 2000; Mushi, 2009). Their work was more successful in three regions: the Kilimanjaro region, the Mbeya region, and the Bukoba region. These regions were also have favorable conditions for the cultivation of coffee and tea plants (Mushi, 2009).

When the Germans established their colony, some of the Tanzanian chiefs and local people who were already converted to Christianity accepted the German colonial rules and policies. The German government also established a few primary schools and demanded cheap labor for agricultural farms (Mosha, 2000; Mushi, 2009; O-saki, 2007; Pandy & Moorad, 2003). It is not clearly stated in the literature if the German language was taught in schools, but it is clearly stated that when the British took over the Tanzanian colony, the English language was made a language of instruction in schools and the educational system was made Eurocentric (Mosha, 2000; Mushi, 2009; O-saki, 2007).

During the British rule from 1919-1961, formal education was mainly provided by missionaries and by the government (Kitta, 2004; Mushi, 2009; Nieuwenhuis, 1996; O-saki, 2005). The focus of education was to produce manpower for work as teachers, secretaries, and laborers in basic processing agricultural industries (Mushi, 2009; O-saki, 2005). The school system was mostly

segregated. There were different schools for White children, Asian children, and African children (Kitta, 2004; Mosha, 2000; Mushi, 2009; O-saki, 2005). O-saki (2005) describes that the science curriculum for African children emphasized gardening, agriculture, rural studies, and general science. Others beside O-saki explain that students were punished for not speaking English at school (Mosha, 2000; Ngugi wa Thiong'o, 1994). Ngugi wa Thiong'o (1994) adds that students who did well in liberal arts subjects were honored and were provided full scholarships to attain higher education in Europe. No scholarships were granted to students who did well in math and science (Ngugi wa Thiong'o). Speaking English was considered more civilized than speaking a native language (Ngugi wa Thiong'o). Mosha (2000) also explains that the materials used in classrooms perpetuated Eurocentric culture, and very little related to African culture was taught, as he describes:

> In high school most of my history classes were about West European history, a few on American history, and almost none on early African, Asian, or South American histories. In English literature, we knew Shakespeare's works like the backs of our hands and nothing about African literature. (p. 172)

Both Mosha and Ngugi wa Thiong'o argue that the colonial educational system destroyed African identity. In addition, Ngugi wa Thiong'o argues that teaching and learning science through the Eurocentric perspective has contributed to the current issue, in which African people view science as not African based and therefore not part of their culture.

Based on Ngugi wa Thiong'o's (1994) perspective about science education in Africa, I argue that African people still practice their traditional science and

technology in everyday activities. Traditional scientific knowledge is still active, especially in traditional agriculture, medicine, and liquor production. The problem is that most African elites have internalized an attitude that African science is primitive and inferior to Western medicine, as well as agriculture and other forms of production. Consequently, African people, especially in Tanzania, are lagging behind economically as well as socially despite the fact that they have rich natural resources in the country. And like in Sub-Saharan nations, the Tanzanian citizens, especially those who were involved in politics, were not so happy with the colonial educational system (Mushi, 2009). After gaining political independence from Great Britain, they began an effort to reform the educational system along national rather than tribal structures (Kassam, 1994).

The Tanzanian Educational System after Colonialism

Immediately after independence in 1961, the new government reformed the educational system (Kassam, 1994). This newly reform educational system focused on training a workforce to build a new nation (Kassam, 1994). Racial discrimination in education was abolished. Kiswahili was promoted as a national language and was made a language of instruction for primary education (Mushi, 2009; O-saki, 2002). In 1967, Julius Kambarage Nyerere, Tanzania's first president, introduced a new form of education known as "Education for Self-Reliance" (ESR). The major intent of the ESR philosophy was to develop students' learning enquiry, critical thinking skills, and self-confidence (Kassam, 1994; Kitta, 2004; MOEC, 2001; O-saki, 2005, 2007). In general, ESR was introduced because Nyerere wanted Tanzanians to

develop their own nation instead of depending on foreign donors, as stated in one of his speeches to the nation states:

> Certainly, it is no use for us to wait for someone else to come and improve things for us. Who would do it? Even when we were governed by colonialists for 80 years we did not have our country developed for us. In fact there is no one else except for ourselves who could develop our country. We cannot allow our children to grow up in lives, which are the same as our grandparents…. What we have to do is to wake up. We have been sleeping too long and saying for too long that our evils are the 'will of God'. Did God not give us brains to use? Did he not give us hands and arms? Did he not give us land? With these things we can change our poverty. (Mushi, 2009, p. 95)

Mushi (2009) also explains that Nyerere as an experienced secondary school teacher and later an economist understood well the importance of education for economic development as well as for societal liberation. Others beside Mushi also describe that Nyerere wanted the educational system to be universal, objective, and descriptive (Nasongo & Musungu, 2009).

In the early 1970s, Tanzanian primary education was made universal and was governmentally controlled (Mushi, 2009). In addition, tuition and school fees at all educational levels were abolished (Kassam, 1994; Mushi, 2009). Politically, the new Tanzanian government embraced socialist practices as opposed to capitalist practice (Mushi, 2009). Therefore, the enforcement of socialist practices in society and schools made sure that all students, regardless of socio-economic status, were educated in the same schools.

As noted in chapter 1, after gaining independence in 1961, Tanzania decided to nationalize the secondary social science subjects such as geography, history, and literature (Mushi, 2009). The physical and natural science curriculum for secondary schools was not changed (O-saki, 2005, 2007). Since the ESR philosophy was intended to help students develop critical thinking skills and self-confidence, the science inquiry curriculum for secondary schools was imported from Europe. Science teachers were also mostly from Britain, the United States, and other Western nations. In addition, the Nuffield School Service Project of East Africa (SSP) was also adopted in schools where there were Western teachers (O-saki, 2007). The Nuffield School Science Project is a UK-based foundation that provides funds and operates a program that explores innovative approaches to teaching and learning in science and mathematics (Reiss, 2009).

O-saki (2007) also discusses several reasons why the science inquiry programs in the Tanzanian governmental secondary schools were discontinued in late 1970s. These reasons include the following: an increased number of secondary schools, resulting in the lack of enough local science teachers who were trained in the scientific inquiry methods; insufficient funds to accommodate science teachers from abroad; and schools that did not have enough teaching and learning resources to meet the inquiry learning process. There was also miscommunication between Cambridge in Britain, the university that prepared the science inquiry examination, and the Tanzanian Board of Education. This problem in communication caused students to perform poorly in the national examination. Since then, science inquiry

was no longer taught in secondary schools. Consequently, the Tanzanian Institute of Education started to develop its own secondary science curriculum.

Tanzanian Current Educational Practices: Achievements and Problems

The 1970s Tanzanian educational reform under the ESR education policy was significant in the social science curricula. For example, using Kiswahili in primary education and promoting it as a national language has produced positive impacts in terms of socialization and communication within the country and in other East African nations. Kiswahili is currently recognized as a symbol of Tanzanian national unity, identity, and culture (Legere, 2006). Other educational progress in the Tanzanian post-colonial educational system can be seen in the increasing number of students' enrollment at all educational levels. For example, primary school enrollment has increased from 3,908,208 in 2006 to 8,419, 305 in 2010; secondary school enrollment has increased from 675,672 in 2006 to 1,638,699 in 2010; and higher education enrollment in universities and colleges has increased from 40,993 in the 2005/2006 school year to 118,951 in the 2009/2010 school year (Mushi, 2009).

Additionally, the establishment of higher learning institutions is one of the major achievements in Tanzanian history, especially in the area of medicine. Currently, there are at least three major medical schools, namely Muhimbili University of Health and Allied Sciences, Hubart Kairuki Memorial University, and Bugando University College of Health Sciences. There are also other important universities, like the University of Dar-es- Salaam, the first Tanzanian university established in 1970, and Sokoine University of Agriculture, Forestry, and Veterinary

Science, which was established in 1984. In general, there are more than 30 higher learning institutions within the county. Eleven out of 30 are public and the rest are under religious auspices and the private sector (Mushi, 2009).

Although Tanzania has reached the achievements described above, there are still many challenges and problems to be addressed. The first of these is that despite the fact that more and more children are receiving formal education, the socio-economic development for most people is still poor. Data shows that almost 30% of the Tanzanian population is living below the national poverty level (Sweya, Kabisama, & Kipobota, 2012). Secondly, there are complaints that Tanzanian universities and colleges are currently producing graduates who are not qualified in the job market because they do not receive the quality of education that can enable them to excel or be competitive (MOEC, 200; Mushi, 2009; Nieuwenhuis, 1996).

The third problem is that most of the governmental secondary schools do not have qualified science teachers, science books, and other learning resources like laboratory tools and chemicals (O-saki, 2007; Semali &Mehta, 2012). The fourth is a teacher-student ratio that is too high (Mushi, 2009; Nieuwenhuis, 1996; O-saki, 2005). Mushi (2009) describes in more detail some of the causes of the problems. He argues that since the resignation of Nyerere from the presidential office in 1985, the governmental school institutions, especially in primary and secondary education settings, have been lagging behind because the new governmental administration started to privatize the education sector. This privatization process is a result of pressure from the World Bank, the International Monetary Fund (IMF), some of the Tanzanian elite, and some parents who wanted their children to be educated in

English and in private schools. More and more English-only schools from the preschool to secondary levels have been established. These schools also charge higher tuition rates, and therefore, families with lower incomes cannot afford them. Consequently, the Tanzanian government no longer funds 100% of country's schools (Mushi, 2009).

O-saki (2007) also agrees that limited funds from the government have increased problems. Currently, most of the educational projects, such as in-service teachers' professional development, including seminars, workshops, and other school programs, rely on money from donor agencies (O-saki). Study on donor reliability shows that while donor aid helps some schools, it does not meet the needs of all schools in the nation. Also, its impact on solving educational problems is minor (Nieuwenhuis, 1996). The influence of the World Bank and the local elites on the current Tanzanian educational system will be further discussed in chapters 4 and 5.

Secondary Science Curriculum Reform

As mentioned earlier, the implementation of science inquiry curriculum for secondary schools, formally imported from abroad, was discontinued in the 1970s. The Tanzanian Institute of Education has continued to design its own curriculum (O-saki, 2007). This curriculum has been criticized for having too much material to be covered (O-saki, 2007; Semali & Mehta, 2012). Besides, the curriculum's content does not reflect students' cultural practices (Semali & Mehta, 2012). In addition, the process of teaching and learning science in secondary classrooms has been one of memorizing science facts, and it uses a teacher-oriented approach (Nieuwenhuis, 1996; O-saki, 2007; Semali & Mehta, 2012). For several years, Tanzanian secondary

science curriculum has been known as content-based. This means that teachers present the science content while students listen and take notes (Kitta, 2004). This type of learning approach is called a "banking form of education" by Paulo Freire (1970), because teachers deposit knowledge and students receive that knowledge without participation. In other words, a banking form of education does not develop students' participatory skills; students are viewed as individuals who are like empty vessels who must receive the content from books and teachers (Freire, 1970).

Researchers like Nieuwenhuis (1996) suggest that Tanzania, as well as other Sub-Saharan nations, need to improve science education in order to produce scientists able to improve the nations' infrastructure, and therefore speed up socioeconomic development. Nieuwenhuis explains further that in order to provide inquiry-based science education, which promotes students' critical thinking and creativity, African nations have to improve pedagogical practices. He states science education should not focus only on cognitive learning skills, but also should provide students the opportunity for hands-on experiences.

In 2005, the Tanzania Ministry of Education published a new science curriculum for secondary schools, which is called "A Competence-based Curriculum" (MoEVT, 2005). Competence-based curriculum is a learner-centered curriculum. Students are required to participate fully in their learning process (Schiro, 2008). Although it has been almost 10 years since this learner-centered curriculum has been introduced in schools, results are not seen to be very impressive. Semali and Mehta (2012) describe that despite the fact that the new science curriculum for secondary schools emphasizes the learner-centered approach, the content within

the curriculum is still irrelevant to students' everyday lives. Mabula (2012) also adds that the new science curriculum is filled with information that teachers have insufficient time to cover. Consequently, the teaching and learning practice in secondary schools remains focused on finishing syllabi rather than learning scientific theories and practices (Mabula, 2012).

Data also shows that the number of students opting to study science subjects in secondary schools is decreasing despite the fact that students' enrollment in secondary schools has been increasing. Data from the National Examination Council of Tanzania (NECTA) website shows that in 2011 there were 658 O-level students at one of the government secondary schools in Dar es Salaam who sat for the nation examination, but only 89 students were examined in physics, and only 39 out of the 89 passed. The same situation occurred in chemistry: 94 students sat for exam, and only 59 out of the 94 passed. The worst results are shown in biology and mathematics. Only 287 out of 658 passed biology exams, and only 88 out of 658 passed mathematics exams (NECTA, 2011). Based on this data and also on other issues discussed in this literature review, it shows that there is the need to reexamine the current Tanzanian educational system from a different angle.

Therefore, post-colonial theory and scientific inquiry theory are used in order to bring insight to the historical complexity affecting the current Tanzanian educational system. In order to discover why the Tanzanian current educational system continued this way, the researcher uses two theoretical lenses as approaches to analyzing data. The post-colonial theory is used for analyzing the issue of power related to language, politics, and economics as they affect the science

education in Tanzanian secondary schools. The scientific inquiry theory in this research is used for three purposes. The first purpose is to analyze the implications of using English only as a language of instruction in science classrooms. The second purpose is to research the effects of a Eurocentric science curriculum in secondary schools. The third purpose is to explore the pedagogical struggles of teaching and learning science in schools that have limited resources, unqualified science teachers, and inadequate school facilities.

Focusing first on reexamining the education system through the critical perspective of post-colonial theory is a powerful approach in which educators explore new possibilities that critically focus on the purpose of education, rather than on reconstruction of power relationships (Hall, 1996b; Manathunga, 2006). Other education theorists, such as Giroux (2005) and Apple (2004), argue also that any type of education can be static if the educational developers have fixed ideas about education. That means fixed ideas about education can deny students the opportunity to think for themselves and to be able to manipulate the knowledge learned at schools in their daily activities. Perhaps the Orientalism ideology that has been internalized by some of Tanzanian elite, which describes African culture, science, and technology as primitive and inferior to Western culture and science, is inhibiting our students from learning. What this means is that students are not given the opportunity to learn science in a way in which they could discover new scientific knowledge about the environment around them. This type of educational system, therefore, is called by Dewey (2001) “the Waste in Education”, which means students’ lives get wasted while they are at school and afterward because of

inadequate preparation. From Dewey's point of view, education has to have connectivity to the students' everyday life experiences, otherwise their life will be wasted; he states:

> From the standpoint of the child, the great waste in the school comes from his/her inability to utilize the experiences he/she gets outside the school in any complete and free away within the school itself; while on the other hand, his/her unable to apply in daily life what is learned at school. That is the isolation of the school-its isolation from life. When we think that we all live on the earth, that we live in an atmosphere, that our lives are touched at every point by the influences of the soil, flora, and fauna, by considerations of light and heat, and then think of what the school study of geography has been, we have a typical idea of the gap existing between the everyday experiences of the child and the isolated material supplied in such large measure in the school. The child can carry over what he learns in the home and utilize it in the school; and the things learned in the school he applies at home. These are two great things in breaking down isolation in getting connection to have the child come to school with all experience he has got outside the school, and leave it with something to be immediately used in his everyday life. (p. 46)

I take Dewey's point of view about education as a challenge for educators, especially in countries like Tanzania, where the country inherited the colonial form of education, so its foundation was not based on local people's educational philosophy and culture. Perhaps the Tanzanian elites should ask these questions: How does our

educational system help students to bridge classroom science knowledge to their everyday way of life? How does the current educational system help students see and treat their surrounding environment differently as it is compared to the colonial past? Why does almost half of Tanzania's population still live in poverty despite the fact that the nation is surrounded by rich natural resources? The answers to these questions, at present, remain unknown. This study seeks to develop a better understanding of these questions in order to think about the future in light of the past**.**

Conclusion

This literature review covered the topics related to the Tanzanian education system in four major historical periods: the education system before the colonial period, during the colonial period, during the post-colonial period, and at the current time. This chapter also discussed the purpose of each form of educational system and the way it was and is still provided. In addition, this chapter covers the topic of current Tanzanian educational practices, achievements, and problems and how these problems have a connection to the colonial educational system. Problems such as a lack of qualified science teachers since independence in 1961, donor dependent education, lack of science investigation and experimentation in secondary schools, training for a limited science career focus, fewer secondary students studying science subjects, and the lack of employment for graduates are discussed.

CHAPTER 3

Research Methodology

This chapter describes the research design, data collection, and analysis methods and procedures, research participants, ethical considerations, and researcher subjectivity. In order to get a better understanding of the research problem and adequately examine the research questions, this study employed a qualitative research design in which three forms of data collection (interview, observation, and documentation) were utilized. The major purpose of using all three methods as means of data collection was to get more information to answer the interrelated research questions. Through interviews, participants shared their experiences and beliefs about Tanzanian secondary science education. These experiences and beliefs were then intergraded into the data analysis with what was observed in classroom as well as from documents such as the secondary school science syllabi and the past national examination papers. More details of the research methodology are presented in the following sections.

Research Design

As I stated in the previous section, this dissertation utilized a qualitative research approach to data collection and analysis. Qualitative research strategies were adopted because the research questions seek to understand human experiences and beliefs that cannot be counted in a numerical form. Further, educational researchers have been using qualitative research to explore educational problems that have complex theoretical interactions (Lichtman, 2010). Researchers

also use qualitative research because they get the opportunity to capture the experiences and perspectives of people who have firsthand experience with the investigated problem and learn how these individuals make meaning of their life experiences (Creswell, 2009; Merriam, 2002). This method of collecting data provides a mechanism for qualitative researchers to obtain rich and valid information (Creswell, 2009; Lichtman, 2010; Merriam, 2002; Schram, 2006).

A qualitative research approach differs from a quantitative one in the sense that quantitative researchers test objective theories by examining variables, which are measured and data are analyzed through statistical procedures (Creswell, 2009). In qualitative research, researchers use theoretical frameworks to explore and understand individuals' life experiences in a natural setting (Lichtman, 2010; Merriam, 2002). In this study, therefore, the researcher used post-colonial and scientific inquiry theories as research frameworks, and qualitative methods (i.e., interview, observation, and documentation) were utilized as data collection methods. As described in chapter 1, post-colonial theory and scientific inquiry were used as the researcher's guide in terms of research questions and data analysis. Additionally, using post-colonial and scientific inquiry theoretical frameworks together with one-on-one interviews, data from classroom observation, and documentation provided the researcher with a better understanding of how participants' experiences or perspectives on secondary science education were situated in broader social, historical, and political contexts.

Data Collection

The types of data collected are descriptive qualitative data that were analyzed through a basic interpretive qualitative research methodology. Methods of data collection included documentation, interview, and observation.

Documentation

In this study, the researcher used several documents to look at the current issues and challenges that are facing Tanzanian science education provision. The important selected documents included secondary science syllabi (i.e., Biology syllabus for secondary school Form I-IV, 2005; Chemistry syllabus Form I-IV; and Physics syllabus Form I-IV, 2010); the 2010-12 Form IV national examination results obtained from the MoEVT website (http://www.necta.go.tz/); the 1999 and 2012 Tanzania Development Vision 2025 retrieved from the Tanzania National website (http://www.tanznia.go.tz/); and the 2010 science subjects past national examination question papers, which were obtained at the school site where this research was conducted. The review of these documents focused on the following topics: science subject content, subject objectives, national examination question structures, the patterns of students' examination scores in science subjects, the degree of science subject assessment other than national examination test scores, the Tanzania secondary education training policy, and the degree of secondary science education participation in the 2025 Tanzania development plan. These documents also played a crucial role in data analysis because of the rich information that reflected on data obtained from the interviews as well as from classroom observation.

Classroom Observation

The second strategy for data collection was classroom observation. This observation process was conducted at one of the government schools in the city of Dar es Salaam. Therefore, the observation was conducted only in classrooms in which science teachers agreed to participate in the interview process. Because of time availability, the researcher was able to conduct a total of five observations that included the following: both lecture and laboratory activity in a physics classroom, both lecture and laboratory activities in a biology classroom, and only laboratory activities in a chemistry classroom. Each observation activity lasted between 40 minutes to 45 minutes. During observation, the researcher did not participate in any classroom activities, except taking field notes. No videotapes, computer, or any other type of device was used, except a notebook and a pencil for writing field notes. The observation activities focused on teaching and learning materials such as books, laboratory equipment and substances, teaching methods in lectures and laboratories, and the degree of transition of subject content and objectives from subject syllabus to classroom practice. Additionally, the researcher observed student-teacher ratios, students' classroom participation (i.e., how they ask and answer questions, how they participate in laboratory work, and how they interact with their teacher and classroom environment). After each observation, field notes were analyzed and written according to emerged themes that were later integrated with data from documentation and interviews (Rubin & Rubin, 2012).

Interview

The third source of data collection for this study was a semi-structured, face-to-face, and audiotaped interview that lasted between 45 minutes to an hour. All interview activities took place at participants' work place. The interview questions focused on several specific topics that speak to Tanzanian secondary science education provision. These topics include:

- Participants' experiences in secondary science education provision
- The influence of the colonial school system on the current Tanzanian education provision related to students' performances in science subjects
- The number of secondary students choosing to study science subjects
- The Tanzania Development Vision 2025
- The science curriculum and its role in preparing future scientists
- The contribution of Tanzania science education to reducing poverty
- The impact of the national examination as a single method of evaluating students' academic performance

Interview protocol guides can be found in appendices A through E.

Since participants in this research had various experiences, from administrators to classroom practitioners, the researcher used a number of flexible questions that focused on each group of participants. In addition, there are some general questions that all participants were asked to answer. Interviews with each participant started with general questions and then progressed to more specific, focus questions. The researcher also asked follow-up questions that included both the immediate follow-up questions and, for one participant, during the second-

round interview (Rubin & Rubin, 2012). Immediate follow-up questions were utilized when the interviewee discussed a topic that relates to the research question or something that the researcher did not understand. The follow-up questions after the first round interview were applied after the completion of the coding process, in which information gathered from the first interviews was transcribed and coded according to emerged themes or topics (Lichtman, 2010). In addition to follow-up questions, probing questions were also utilized, especially when the interviewee failed to respond to the main question (Rubin & Rubin, 2012). These probing questions asked the interviewee about the same topic, except the researcher reworded them differently.

Data Analysis

Data analysis involved three steps: transcription, coding, and concepts development (Lichtman, 2010). After each interview, data were transcribed and coded manually until themes emerged (Lichtman, 2010; Merriam, 2002). The coding process involved two forms: open coding and focus coding. Open coding means after transcribing interview information, all related ideas are identified and arranged according to emerged topics, whereas focus coding means that the identified topics in the open coding process are put together to identify major concepts and repeated ideas are omitted (Lichtman, 2010). During the open coding process, the text of each interview was transcribed and the transcriptions were identified and arranged according to the emerging topics or to related ideas (Lichtman, 2010). After finishing the first round of the first interview, all open coding data were categorized into related topics (Lichtman, 2010; Rubin & Rubin,

2012). Due to participants' schedules, conducting a second interview was impossible for most of the participants, except one participant who was able to offer 30 minutes for a short second interview. The data obtained from the interviewing process, classroom observation, and documentation were then analyzed and thematically conceptualized, and each of these was developed into its own chapter (Chapters 4-7).

Access to Research Sites

This study was conducted in Dar es Salaam, Tanzania. The researcher conducting the research is a Tanzanian citizen who is a doctoral student at DePaul University in the United States. Therefore, the procedure of gaining access to research sites and the selection of participants followed the Tanzanian research protocol. According to the Tanzanian Education Research Policy, any research conducted in a K-14 setting or in the education field must be approved by the Ministry of Education office, Commission of Science and Technology, or the Vice Counselor from any of the Tanzanian higher learning institutions. After the approval, the researcher is provided an official letter that he/she presents to the head of an institution or an organization in which the study would be conducted. Selection of participants, therefore, is a negotiable process between the researcher and the head of the institution.

In this study, the procedures of gaining access to research sites began in October 2012 when the researcher wrote an email to the Director of Research, Information, and Publication in the Department of Tanzania Institute of Education about the research process. In April 2013, the researcher met with the director at

the office to obtain contact information (phone numbers) and directions to the Ministry of Education and Vocational Training (MoEVT). After accessing the contact information, the researcher contacted and set up an appointment with the General Secretary and the Researcher Director in the MoEVT office. On the day of the appointment, the researcher was asked by the General Secretary to provide a short summary of the research proposal written according to the Tanzanian research protocol and an official letter from DePaul University's College of Education. Since the approved proposal from DePaul University was different from the proposal that the MoEVT office requested, the researcher was asked to write a one-page, short summary of the proposal that met the requirements of Tanzanian educational research. After the proposal was submitted, the researcher was asked to stop by the next day to pick up the official letters for research approval and to meet with the MoEVT Research Director for more information about the requirements of conducting research in the country.

After meeting with the MoEVT Research Director, the researcher was provided the official letters according to the request. These letters were specifically addressed to individuals in charge of each department, who included the Director General of the Tanzania Institute of Education (TIE), the Director of Secondary Education Department (MoEVT), the Executive Secretary of The National Examination Council of Tanzania (NECTA), and the Regional Administrative Secretary, Dar es Salaam (Attention: Regional Education Officer). Gaining access to the school required more than one process. After submitting the letter to Regional Education Officer, the officer wrote a letter to the District Administrative Secretary,

and then the District Administrative Secretary wrote to the Municipal Director, who then wrote an official letter to the school principal. The major communication strategies that were used during the process of getting access to participants were mostly walking into the offices and speaking with those in charge.

Participants Sampling Procedure

This study involved a total number of nine adults from four different departments who agreed to participate. These participants included: three science teachers (one chemistry teacher, one physics teacher, and one biology teacher); two administrators from the secondary science department in MoEVT office; two curriculum developers from the TIE department (one in charge of secondary mathematics curriculum and one in charge of biology curriculum); and two secondary science education examination administrators from the NECTA department (one in charge of chemistry assessment and one in charge of physics assessment). It was intended that during the meeting with the department heads, the researcher would discuss with them the desired participants for the study; however, the process did not happen that way in each department. At the administration level, the selection of participants depended on individual's schedule and availability. Therefore, some of the department heads simply selected persons who were available to participate. For that reason, there was no scheduling process because the interviews were conducted on same day of the meeting.

At the school site, the researcher was provided with a list of science teachers who the researcher was able to talk with and request their permission to participate. Then the researcher was able to schedule appointments with those who

agreed to participate. In each case, participants were asked to sign the DePaul University's Institutional Review Board's informed consent sheet for participation, and they were clearly informed of the purpose of the research and asked if they were willing to participate. Also they were told that their participation would be non-compensated and that the interview would be a one-on-one, face-to-face tape-recorded interview. Every prospective participant that was approached in this manner agreed to participate in the study. Eight participants out of nine chose to be interviewed in Swahili, and only one chose to be interviewed in English.

In general, all nine participants have experience teaching science in government secondary schools. Five participants out of nine were female, and four participants were men. The participants have a different range of experiences and education levels. One participant, currently teaching chemistry, held a two-year diploma in science education and had 22 years of teaching experience in secondary schools. A second participant, currently teaching biology, held a teaching diploma and a Bachelor of Science degree in biology and has been teaching for 17 years. A third participant, currently teaching physics, held a teaching diploma and Bachelor of Science degree in science education with specialization in mathematics and physics and has been a teaching for 9 years. A fourth participant held a teaching diploma, Bachelor of Science and Master of Science degrees in science education with specialization in physics and mathematics and has taught for 12 years and is currently working as an administrator in TIE department. The fifth participant held a Bachelor of Science and Master of Science in science education with a specialization in biology and has taught in secondary schools for several years and is

currently working as an administrator in the TIE department. The sixth participant, currently working as secondary science education director in the MoEVT office, held a Bachelor of Science degree in agriculture and a Master of Science degree in environment science and had a few years of experience in teaching and 5 years of experience in administration. The seventh participant, currently working as secretary in the MoEVT office, held both Bachelor of Science and Master of Science degrees in science education with specialization in chemistry and biology and had several years of teaching experience and 6 years of experience working in administration. An eighth participant, currently working in the NECTA departments held both Bachelor of Science and Master of Science degrees in science education, specialized in chemistry and physics. This participant has some experience in teaching and has four years of experience in administration. The final participant, also currently working in NECTA department, held a diploma in science education, Bachelor of Science and Master of Science degrees in education with a specialization in physics. This participant has taught in secondary schools for 12 years and has four years of experience in administration. These participants' range of experiences and education levels clearly show that they had enough experiences in secondary education, especially in the government school, since all of them have been working in the governmental institutions for a number of years.

The following table is a summary of participants' level of education, their current positions in the secondary science education sector, and their experiences.

Table1

Participants' Level of Education, their Current Position in Secondary Science Education, and their Experience

Participants	Education level	Current Position	Experience
P1	DE	Chemisty teacher	22 years
P2	DE & BS	Biology Teacher	17 years
P3	DE & BS	Physics Teacher	9 years
P4	DE, BS & MS	Ad-TIE	13 years
P5	BS & MS	Ad-TIE	12 years
P6	B. Ed. Science; M.Ed. Science	Ad-MoEVT	6 years
P7	BS, MS, M.Ed. Science	Ad-MoEVT	5years
P8	B. Ed. Science; M. Ed. Science	Ad-NECTA	4 years
P9	B. Ed. Science; M. Ed. Science	Ad- NECTA	4 years

Note. P = participant; DE = Diploma in Education; B. Ed. Science = Bachelor of Education in Science; M. Ed. Science = Master of Education in Science; Ad = Administration; MoEVT = Ministry of Education and Vocational Training; NECTA = National Examination Council of Tanzania; TIE = Tanzania Institute of Education; BS = Bachelor of Science; MS = Master of Science.

Ethical Considerations

This research was limited to Tanzanian individuals who are responsible for secondary science education provision and who agreed to participate. Further, all participants' names, contact information, and work positions were anonymously referred to in the data analysis. Additionally, the interview data in the analysis chapters do not identify participants by name or their work positions. For example, the data are not referenced as "a biology teacher or a curriculum developer said that"; instead, the data are referenced as "participant or participants explained or

answered." The major purpose of presenting the data in this way is to protect the participants' identities. Also, the name of the school where the study took place was not disclosed.

By enhancing validity and reliability of research, data interpretation and analysis followed the qualitative research approach suggested by Merriam (2002). Analyzing research data without enforcing my beliefs and biases is considered vital in this research. What is analyzed, therefore, includes interview data from participants, data from classroom observation activities, and data from documentation that are related to the research topic. These data were then contextualized with data from existing research that relate to this present study. In summary, the data analysis of this current study focused on the participants' points of view on whether or not the colonial legacy is still present in the current Tanzanian educational system. In addition, the analysis focused on current pedagogical issues and problems that are limiting the provision of quality science education in the Tanzanian governmental secondary school setting.

Researcher Subjectivity

The word subjectivity is used to describe personal interests and perspectives that draw a researcher to conduct a study (Merriam, 2002). In other words, most qualitative research is built upon researchers' assumptions, biases, beliefs, or experiences (Schram, 2006). Subjectivity then has an impact on the way a researcher might formulate research questions, the selection of participants, and the analysis of data (Merriam, 2002; Schram, 2006). Researcher subjectivity is also important in qualitative research because it helps readers to understand the

researcher's intention for conducting a study and approach to data analysis (Schram, 2006). In addition, researcher subjectivity is important for research validity and reliability (Merriam, 2002). This study, therefore, has a foundation based on my assumptions and biases about science education, my firsthand experiences with post-colonial education, and the knowledge of curriculum development that I acquired at DePaul University. As a scientist and an educator, I believe that students can develop talents and become critical thinkers if scientific theories are taught in ways that enable them to manipulate scientific knowledge based on their surrounding environment. In other words, scientific theories have to be taught in ways that provide students the opportunity to discover new scientific knowledge. Teaching science through lectures and recipe-like laboratory books encourages memorization and cheating and also limits students from developing talents and from discovering new scientific knowledge. Moreover, school curricula have to be developed in a way that helps students who have placed their hope in education actually achieve the kind of learning they need to excel on their future life.

Moreover, I am a recipient of a K-14 Tanzanian post-colonial education that was inherited from Great Britain in 1961. From the experience I had in secondary science classrooms, I argue that Tanzania, as well as other developing countries that inherited formal education from their colonizers, could envision meaningful change in science education if people would recognize the colonial educational legacy and its impact on science education. Integrating both Eurocentric science and traditional science might open up new possibilities of teaching science that could transform societies' socioeconomic status. This does not mean that Eurocentric science is bad,

nor that societies should ignore Eurocentric science education, rather I argue that most science theories are not static. Therefore, students should be given the opportunity to manipulate these theories according to their cultural practices. In this way, learners would be enabled to discover new scientific knowledge that might be vital for Tanzanian socioeconomic development. This study was, therefore, an opportunity for the researcher to learn from others' perspectives about science education as a basis for further informing the researchers' and the wider educational community understanding of Tanzanian science education practices, curriculum, and possibilities for change.

Summary

Chapter 3 in this paper describes research methodology that includes research design, data collection methods and procedures, access to research sites, participants sampling procedure, data analysis, ethical considerations, and research subjectivity. Also, guidelines for maintaining quality research and analysis are described. The following four chapters present and conceptualize research data and provide implications based on the research.

CHAPTER 4

Tanzanians' Perspectives on the Post-colonial Educational System

The achievement of independence in Sub-Saharan African nations in the last half of the 20th century was a defining historical moment, and people hoped for a bright future life (Young, 2004). Being free from colonial power gave African people a sense of excitement, hope, and anticipation that the struggles of life they endured for centuries would be over. In addition, the new governments promised to abolish the colonial legacy that was characterized by socio-economic inequalities (Moshi, 2009; Samoff, 1999; Young, 2004). In order to eliminate the socio-economic inequalities, most of the new governments, including Tanzania, restructured the colonial educational system according to the society's structure and culture (Mushi, 2009). Tanzania also abolished schools' racial segregation and other educational inequalities based on gender or religious background (Kassam, 1994; Mushi, 2009). The new government opened doors to every child to receive a free education. Even children from non-Christian families who were denied education during the colonial rule were welcomed (Mushi, 2009).

On the other hand, education was regarded as a pillar for people's socio-economic development. Making education accessible to citizens was the key solution thought to speed up socio-economic development (Kassam, 1994; Samoff, 1999; Young, 2004). In order to meet those goals, the educational policies were formulated with a focus on equipping students with the skills needed for employment, especially in the governmental sectors (Nabudere, 2007; Samoff, 1999). The education sector became important because more children attended

schools (Mushi, 2009). The new educational policies, however, did not necessarily change the colonial educational system. School structures, hierarchies, and political control over public schools were maintained (Mushi, 2009). In addition, Tanzania opted to maintain English as the language of instruction in secondary schools and colleges (Mushi, 2009).

In general, the attainment of the political independence period in the Sub-Saharan African nations was a historical moment that gave people hope for attaining quality education and high socio-economic development. That dream, however, has never come true for the majority of people of the Sub-Saharan Africa (Samoff, 1999; Young, 2004). For example, in Tanzania, many children and adults were able to access free primary education in the 1970s and in the early 1980s (Kassam, 1994; Mushi, 2009), but people still lived in extreme poverty, especially in rural areas. As noted in chapter 1, today more than 80% of Tanzanians are still living in rural areas with limited access to safe drinking water, clinics, electricity, and reliable communication (Mushi, 2009; National Strategy for Growth and Reduction of Poverty, 2005).

As described in chapter 2, the number of students' enrolled in Tanzanian schools has increased numerically (MoEVT, 2012; Mushi, 2009; NECTA, 2012). For example, the number of secondary schools, both government and private, have increased from less than 1000 in 2000 to more than 4000 in 2012. This increase of school enrollment in all educational levels has not had major effects on the Tanzanian citizens' socio-economic development. In short, optimism and hope for

societal and economic change through education that came with independence has only been partially achieved.

As noted in chapter 1, the aim of this present research is to understand how the colonial power related to language, politics, and economics affects science education in Tanzania secondary schools. This research will reveal the implications and challenges in Tanzanian governmental ordinary-level secondary schools (O-level) settings. The research focuses on the governmental four-year level secondary schools. The main focus is on problematic issues that might limit both boys and girls from pursuing science in post-secondary education. Further, the researcher is interested in learning how secondary science teachers and administrators experience Tanzanian secondary science education. This study is guided by three questions: To what extent does the legacy of colonial education and a Eurocentric mindset play a role in how secondary science education is provided? How do science teachers and administrators from the Ministry of Education and Vocational Training (MoEVT), Tanzania Institute of Education (TIE), and National Examination Council of Tanzania (NECTA) perceive secondary science education? Do their attitudes and beliefs reflect the science curriculum and how science is practiced in classrooms?

This chapter provides the analysis of the data results to the first question, which was obtained through interviewing and classroom observations. As mentioned earlier, participants include three science teachers who are currently teaching at one of the government secondary schools in Dar-es- Salaam, two science education administrators who currently work as science curriculum developers,

two science administrators who currently work for the national Examination Council of Tanzania, and two science education administrators who currently work in the Tanzania Ministry of Education and Vocational Training. In order to understand the historical complexity of the current Tanzanian science educational system, the data is analyzed by using both post-colonial theory and science inquiry theory as analytic lenses. In addition, the data are contextualized with other existing research that relates to educational issues in Sub-Saharan African nations and other parts of the world.

The Tanzanian Educational System after Colonial Rule

When Tanzania gained independence from Great Britain in 1961, the educational system was segregated; children of African origin were provided low quality education compared to Western or Asian children. However, after the declaration of independence, Tanzania abolished all school discrimination based on gender, race, or religious background (Kassam, 1994; Mushi, 2009; O-saki, 2007). In the 1970s, Tanzania established a national institute, the Tanzania Institute of Education (TIE), which is responsible for developing curricula for primary, secondary, and teacher colleges (Kassam, 1994; O-saki, 2007). As mentioned before, despite the fact that more and more Tanzanian children are receiving formal education, the outcome of their education does not have much impact on the socio-economic situation. In other words, the Tanzanian post-colonial educational system has not yet produced enough positive outcomes as was intended after independence in 1961. Some people of Tanzania still experience the same struggles as their parents experienced during the colonial rule, such as extreme poverty, poor

infrastructure, and lack of social services, which are common phenomena in rural areas.

In this present study, participants were asked to share their experiences with the Tanzanian post-colonial educational system. Their responses varied depending on the degree to which they believed and understood the differences between the colonial educational system and the current Tanzanian educational system. Three out of nine participants responded that the current educational system has nothing to do with the past colonial educational system. This is because they believed no colonial influence remained after independence in 1961, since Tanzanians took over the educational system. One among the three participants, an educational administrator, said: "When we got our independence, the colonial educational system was abolished; the new nation insisted on educational equity and quality for all. Even now education is provided for all children, and good students are granted priority and scholarship." Another administrator who believed that the colonial educational legacy does not exist in the current Tanzanian educational system described:

> When you look at the purpose of the colonial education system it was to train individuals needed to work for the colonizer, and that purpose ended after we gained our independence. I think the problem is with us, that we have not yet ourselves improved our learning and teaching environment. But, it does not show any influence of colonial education. Maybe our educational system is facing problems of poor management and corruption. However, we cannot say that poor

> management and corruption are the results of the colonial educational system.

The interviewer asked, “What do you mean by corrupt?” The participant responded:

> I mean leaders or anybody in the administration putting schools’ money in their pockets instead of using it for school improvement. Corruption happens in families too. Let us say a husband or anybody in that family decides to spend family money on his/her own.

The participant’s responses suggest that the current educational system has some issues of poor management and corruptions, which influence the teaching and learning environment and that might be preventing the educational sectors from developing. For these reasons, then, the past colonial educational system does not have any responsibility for those issues. The current issues and problems, such as the lack of learning and teaching resources and overall school environment, will be discussed further in chapter 6. The issue of corruption in the educational system has been found in other Sub-Saharan African nations. Studies on corruption in the educational sector have been conducted in Uganda, Ghana, and Zambia. The results of these studies show that there is consistent corruption by government officials with regard to school grants from either the national education budget or from donor agencies (Francken, 2009; Mocan, 2008; Reinikka & Svensson, 2004). The findings in these studies support the idea that the Tanzanian educational system might also experience these issues..

Another issue that seems to be problematic in the Tanzanian post-colonial educational system is science curriculum implementation. It was noted previously that since the 1970s, Tanzania, through the TIE department, has been in charge of developing its own educational curricula (O-saki, 2007). Responding to the question of whether or not the colonial education legacy still influences the current educational system in Tanzania, one of the education administrators said that the colonial education legacy no longer exists in the current educational system because since the independence, Tanzanians have been responsible for developing the school curricula. The current problem is how the curricula and the training policy are implemented. The participant explained:

> Personally, I do not see colonial education influencing our educational system because now we control everything from curriculum development to the school training policy. I think today we are the ones who prepare and implement our own curriculum and the school training policy. While we remain under the self-reliance training policy [introduced by President Nyerere in 1967], our problem is around how this policy is implemented.

"Could you explain more about the implementation?" The interviewer asked. The participant responded:

> As women, we were able to study science because our teachers were good and they made us like science. Back then teachers were committed, motivated, and they were ready to spend extra time to help us. But now you can't see that. Teachers are protesting for their

> employment benefits. The truth of that is open. You have visited some of the schools. Do you think the teachers are willing to work?

Since in the previous response the participant mentioned school training policy, the interviewer was interested to learn if the teaching and learning in English policy could have any impacts on secondary students. The interviewer asked: "How can you describe the teaching and learning in English policy in secondary school?" The participant responded:

> Personally, I do not believe that teaching in Kiswahili in primary schools affects students' learning process in secondary schools. I share that experience of my educational journey. I know, people argue that young children learn languages more easily than adults, and therefore, primary students should learn in English. I do not believe that. By the way, it is true those primary students learn English as a subject from second grade to seventh grade, so they do have six years, which is enough time for mastering the English basics. If English is taught as it should, then there would be no problem. I'm continuing to defend my position that implementation is a problem. Myself I received all my education trainings from governmental institutions. I remember when I finished my primary school and I went to a secondary school where some of my fellow students came from English medium schools. I know for the first four or maybe five months I did struggle a little bit, but after that I was the best. So, you cannot say that the shifting of languages of instruction from primary

> to secondary have major impacts on students learning process. It just depends on a child's learning capacity. To tell you the truth, our veteran old English teachers were good and I appreciate them. They were really teaching. Nowadays, the implementation is poor; teachers are not doing what they are supposed to do. But, if you have good teachers, learning in English in secondary school would not be a problem.

The participant's responses indicate that teachers are responsible for the failure of the science curriculum in secondary schools because they are not motivated and not committed to their jobs. On the other hand, studies show that Tanzanian science teachers are not motivated because of the work conditions that seem to deny their benefits. For example, a teacher's low salary discourages them from investing more time on their teaching career. They have to look for other alternatives to support their families (Kitta, 2004; Mushi, 2009; Nieuwenhuis, 1996; O-saki, 2005, 2007; Semali & Mehta, 2012; Vavrus & Bartlett, 2013). Mushi (2009) also explains that teachers' working conditions have been worsening after the government decided to expand secondary education in 2000. The number of secondary school facilities was increased, but most of these schools have no housing to accommodate teachers. The issues regarding teachers' working conditions will be further discussed in chapter 6.

This participant also discussed the policy concerning language of instruction. Currently, the Tanzanian training policy requires primary students to be instructed in Kiswahili and secondary students to be instructed in English. Several studies have been conducted on the impact of shifting the language of instruction from primary

education to secondary education. The findings of these studies show negative impact. For example, studies conducted in England, Wales, and other parts of Europe describe that the shifting of language of instruction for secondary students limits them from building upon their previous knowledge learned in primary education (Hunt et al., 2008). Vavrus and Bartlett (2013) conducted research in Tanzanian secondary schools with science teachers. Their research findings show that English as a language of instruction in secondary schools has a significant negative impact on learning and teaching pedagogy. First of all, both teachers and students are not fluent in English.

Secondly, as a consequence students find some difficulty in understanding subjects in English. Teachers, therefore, are encouraged to use closed questions rather than open questions. Vavrus and Bartlett (2013) argue that using closed questions in classrooms hinders the implementation of the inquiry-based pedagogy and that the shift to English is, in part, responsible for this. Stephen M. Neke (2005) also adds that English is not well understood by most Tanzanian teachers and students because the language is not commonly used in everyday activities. Neke makes clear that teaching and learning in English in post-primary education has created a negative impact on both teachers and students. The issue of language of instruction in Tanzanian education and training policy will be explored more in the following section. The next section describes the issues that are thought to be the remnant of the colonial legacy in current Tanzanian secondary science education.

The Colonial Legacy in the Current Tanzanian Educational System

As mentioned in the previous section, participants in this study had different opinions with regard to the Tanzanian post-colonial educational system. Four out of nine participants believe that the current educational system still has some elements of the colonial educational system. The elements described as still remaining are as follows: the secondary science content, socio-economic status, the use of English for instruction in secondary school, and the social alienation that results from them.

Secondary Science Content

It is described in Chapter 2 that the current science curriculum for secondary schools has too much material to be covered (O-saki, 2007; Semali & Mehta, 2012). In addition, the curriculum content does not reflect students' everyday cultural practices (Semali & Mehta, 2012). This problem was discussed in the current research by some of participants. One participant, who teaches science, explained the current situation of secondary science curriculum in the following manner:

> Tanzanian education still uses the same system that was used by the colonizers. For example, in science we learn many things but we cannot apply them in everyday life. That is a big problem. It may be true that every topic is important, but there are some topics that are useful and students can specialize in those topics. That way we would avoid teaching them material they will never use.

The participant's statement suggests that the current Tanzanian science education curriculum offers an excess of topics. This corresponds to O-saki (2007) and Semali

& Mehta (2012), who indicate that the Tanzanian secondary science curriculum covers more information than needed. This participant's statement corroborates the latter study by suggesting that students learn unnecessary science materials that are hardly used on a daily basis.

Socio-economic Status

During the colonial period, the socio-economic differences between the colonizer and the African people became evident (Mosha, 2000; Mushi, 2009). Schools were segregated based on race, socio-economic status, and religious background (Kassam, 1994; Mosha, 2000; Mushi, 2009; O-saki, 2007). These kinds of school segregations were abolished after independence. Also, the socio-economic differences were less often observed because of the larger social and economic goals of the socialist government system (Kassam, 1994; Mushi, 2009). In this research, one participant described the new emergence of school segregation and the socio-economic status gap between the elite and the rest of the population as follows:

> There are still colonial education influences in the current education system. This is because during the colonial period, students of African origin were not provided a good education as compared to children from the colonizers' families. This privileged type of education gave the colonizers power over the African population. There are still remnants of that system in our society because politicians and the elite are the products of that system. Currently, the elite are educating their children in private schools or are sending their children abroad for better education. Consequently, these same elite and their families

> and relatives are continuing to take over the best positions in governmental and other important offices. Meanwhile, the common majority of people are sending their children to government schools where there are not enough teachers, and where there is lack of both learning and teaching resources. As a result, the society is producing a generation that cannot question or challenge the authority. This growing generation is also unprepared to solve their economic problems. They have the mindset that politicians will provide for them and will take care of their problems.

The participant's statement indicates that there is a growing socio-economic gap between the elite and the majority of Tanzanians in terms of getting access to good education. It also shows that the elite have maintained socio-economic power, but the common people are economically struggling, and their children have limited access to good education. Meanwhile, politicians have made people believe that they are bringing development to every citizen; they do not foster self-esteem. In other words, the majority of poor Tanzanian people believe and trust in promises from politicians who say they will bring them better life. Consequently, people are becoming more and more dependent on governmental help rather than on themselves. Mushi (2009) also discusses the issue of socio-economic gaps between Tanzania's wealthy and poor populations. Mushi describes that since the resignation of President Nyerere in the mid-1980s, children from poor families have been struggling to access good education due to the government's inadequate educational policy.

As noted in Chapter 2, the new administration after Nyerere embraced the capitalist economic system, free market trade, and privatization (Mushi, 2009). Since then, the governmental school institutions, especially in primary and secondary settings, have been lagging behind. Mushi (2009) explains that school privatization is a result of pressure from the World Bank, the International Monetary Fund (IMF), some of the Tanzanian elite, and some parents who wanted their children to be educated in English and in private schools. Consequently, the current educational system has been turned into a business, as opposed to its previous role as a service. More and more English-only schools from the preschool to secondary levels have been established. These schools also charge higher tuition, and therefore, families with lower incomes cannot afford them. Consequently, the Tanzanian government no longer funds 100% of the country's schools (Mushi, 2009).

Reducing government support for education left many schools without financial resources. This resulted in a lack of laboratory materials and a decline in science laboratory practices (Lyimo, 2010). Additionally, the amount and length of time in course work for pre-service teachers was reduced. Consequently, pre-service teachers are graduating with a diploma without enough knowledge of teaching pedagogy (Lyimo, 2010). O-saki (2007) also describes that limited funds from the government made the Tanzanian educational sector donor dependent because most educational projects, e.g., workshops, seminars for in-service teachers, rely on money from donor agencies. Nieuwenhuis (1996) also argues that relying on donors' money for school projects has its own problem, because donors' money

does not often meet the needs of all schools in the nation. As a result, most governmental schools suffer from lack of funds to support school programs.

The Existence of Social Alienation

Another issue that was described by participants as colonial legacy in the Tanzania educational system is social alienation. This means that schools, especially boarding schools, tend to separate children from parents. Also, school graduates are frequently moving from rural areas to cities to look for employment and a better life. This process separates them from their communities. Consequently, formal education has been perceived as an escape from farm work and from poor living conditions with limited social services, such as clinics, reliable communication, and electricity. The participant who is currently working as an administrator describes this phenomenon as follows:

> The social ramifications of the colonial system still exist. First of all, acquiring formal education is still perceived as a gateway to escape farm labor and the hard life of rural areas. Secondly, most students still have to separate from their families to attend schools, especially those attending boarding schools. Secondary and college graduates have to separate from their families or communities because they are prepared for white-collar jobs, which are always in the cities. In general, the colonial educational system still has major impact on the current schooling system as well as on the school training outcomes.

"What would happen if the farming sector would be improved?" the interviewer asked. The participant answered:

> The system was not founded to benefit the farming sector from the beginning. Although back then we used to sing songs about facing our hardships, I have never seen anybody who graduated from college and after that went back to work in the farms. Those who are working in farms have no access to market or access to sell their products at a reasonable price. Maybe, if there was an equal distribution of resources and services, then people could live anywhere in the country. Since there is a lack of reliable social services, such as clinics, roads, and good schools in most of the rural areas, educated individuals get discouraged to stay in such an environment.

The participant's description not only suggests that formal education is causing social alienation in the Tanzanian society, but also that the lack of necessary social services in rural areas contributes to the situation. The participant's response provides a unique perspective that doesn't seem to have been recognized in previous research. Previous studies such as Mosha (2000) and Ngungi wa Thiong'o (1994) argue that the educational system of colonizers separated children from families by educating them in boarding schools; also the elite Tanzanian group distanced themselves from the society (Musha, 2000). Their argument is still accurate and as the participant describes: that currently, some students have to separate from their families to attend boarding schools. It is also true that graduates have to leave their families because they have to look for white-collar jobs in cities. However, the participant reminds us that not only the educational system causes

social alienation, but also the harsh life in rural areas is a major cause for young people moving away from their families. As noted in Chapter 2, Tanzania has a huge number of youth who have been migrating from rural areas to cities in search of a better life without having any educational qualifications (Mushi, 2009). This problem has also been observed in neighboring countries, such as Kenya, Uganda, and Malawi (Mushi, 2009).

The Language of Instruction in Secondary School

In this study, the use of English as a language of instruction in secondary school was described as the colonial educational legacy. One of the participants described how this type of colonial legacy affects students as follows:

> The current educational system still has some practices that are taking the Tanzanian educational system back to the colonial era. For example, teaching students in English. The current mandated training policy in the government school setting requires students from pre-kindergarten to grade seven to be instructed in Swahili, and English is taught to them as an independent subject. When these students start secondary school, the language of instruction shifts from Swahili to English. Shifting from one language to another language creates a difficult learning situation for students. It is hard for them to master their studies at the secondary level, especially for those who did not get the basics of English language in primary education.

The participant's discussion about the policy of teaching English in secondary schools suggests that students, especially those who did not master the language of

English in primary schools, do struggle with English when they are in secondary schools. This also supports Neke (2005), Brock-Utne (2004), Qorro (2000), and Vavrus and Bartlett (2013), who argue that the use of English as a language of instruction in Tanzanian secondary schools is a barrier between students and teachers.

Data from classroom observation that was obtained during this study also supports the fact that both secondary students and teachers are impacted by the English policy. In this study, the researcher observed this fact to be true in a biology class. In this particular lecture, students were learning about "growth in flowering plants," and students were required to explain the concept of seed germination. The teacher wrote down a list of seeds that are locally grown in Tanzania. One seed listed was "millet."

Teacher: What is millet in Kiswahili?

Student 1: Ngano [means wheat]

Teacher: No. Who else wants to try? [Students remained silent]

Teacher: Millet means "mtama."

Students: That is it?

Teacher: Yes. It is mtama.

The students were surprised to find out that every one of them knows what mtama is in Kiswahili, because that type of grain is familiar in the environment, despite the fact that no one knows its name in English. The second seed that was discussed in that classroom activity was a kidney bean. The term kidney bean seemed unfamiliar

to both teacher and students. After writing down the word kidney bean on the blackboard, the teacher asked students:

> Teacher: What are kidney beans? [Students were looking at each other and no one said a word. After a short period of silence, the teacher spoke.]
>
> Teacher: I do not know either. I do not think we grow kidney beans here in Tanzania. Don't write it down.

In reality, kidney beans are grown everywhere in Tanzania, and it is a type of grain that is consumed in almost every meal in most Tanzanian families. Since the word "kidney bean" was not culturally familiar, the subject was considered unknown.

Birgit Brock-Utne (2007) also observed English difficulty in science classrooms, especially in biology and geography classes. In this activity, Brock-Utne designed an experiment in which the teacher taught the same subject topic in English and in Kiswahili. The research findings show that when students were instructed in English, students' participation was limited; they did not answer or ask questions. For example, in a biology class, some students failed to distinguish between a bird and a fish; however, when the same topic was taught in Kiswahili, the students' learning atmosphere was different. Students seemed to understand the subject, and they were eager to answer and ask questions. They also shared some knowledge on the subject that was not written in the biology textbook. The teacher also learned some new knowledge from students.

The same situation was observed in the geography classroom. Brock-Utne's (2007) study concluded that when students are taught in unfamiliar language, they

acquire “adaptability qualifications.” This means that students learn to obey, to be quiet. Finally, they become indifferent and apathetic. Brock-Utne, therefore, argues that the current Tanzanian training system still reflects a colonial power that trained its work force to obey their masters and become compliant workers. However, if Tanzania wants its people to be productive and to develop creativity and critical thinking, then students have to be taught in Kiswahili. Meaningful knowledge that reflects student’s lives is very important to their development, not only in socio-economic terms, but also emotionally and mentally (Brock-Utne).

There has been a continuous debate over the current Tanzanian language of instruction policy in secondary education settings. The debate over which language should be used to instruct secondary students has resulted in divided groups with majorly different perspectives. For example, scholars such as Brock-Utne (2004), Masato (2004), Neke (2005), Qorro (2000), and Vavrus and Bartlett (2013) argue that the use of English as the language of instruction in Tanzanian governmental secondary schools is a barrier for not only students but also teachers. Both teachers and students are insufficiently proficient in the language. Consequently, classroom practice has resulted in negative impacts.

On the other hand, there are some Tanzanian scholars such as Maghimbi (1996, 2000) and Ogita (2000) who argue that instructing secondary students in English is vital. Knowing English gives students advantages that help them access employment outside Tanzania. In addition, English is the language of science and technology, as opposed to Kiswahili. Unfortunately, teaching secondary students in Kiswahili denies them the opportunity to gain broader knowledge and the

possibility of raising their standard of living (Neke, 2005). Maghimbi (1996, 2000) and Ogita (2000) argue that knowing English serves as a powerful mechanism to acquire a global knowledge of science and technology. English also gives a person access to socio-economic power, as compared to Kiswahili.

There are also some scholars who have a different opinion about the usage of English or French in the Sub-Sahan African nations. For example, Pennycook (1998) argues that colonial languages that were developed during the colonial era have a lasting impact on people's attitudes, perceptions, and beliefs about English or French languages. Consequently, these beliefs have lived and transformed themselves into a set of perceptions and meanings that speaking English or French provides a person an access to power, culture, and political and economic benefit.

In general, the issue of the language of instruction in Tanzanian post-primary education settings has been classified as both a political and an economic issue (Brock-Utne, 2007; Vavrus & Bartlett, 2013). It was mentioned in Chapter 2 that in the mid-1980s the Tanzanian governmental priority started to shift from socialist politics and economic systems to capitalist politics and economic systems (Mushi, 2009; Samoff, 1999). These capitalists' forms have also influenced the provision of the education in the country. The school privatization process has turned the Tanzanian educational sector into a profit sector by reintroducing English-only preschools, as well as primary schools and secondary schools (Mushi, 2009). The establishment of the English-only schools has increased the misconception about the English language. Parents have been convinced that English is the language that would provide their children more access to knowledge, employment, science,

technology, and socio-economic development (Brock-Utne, 2007; Neke, 2005). This type of belief and ideology has complicated the secondary school language policy reform process.

Brock-Utne (2007) explains that in 1995, the Tanzanian Ministry of Education announced that Kiswahili would be implemented as the language of instruction in secondary schools by the year 2001. This policy, however, has never been implemented because of political interests (Brock-Utne, 2007). Vavrus and Bartlett (2013) have conducted several educational studies in Tanzania. Their most recent study on *International Pedagogies, National Policies, and Practices in Tanzania* has research findings that suggest that English is a major problem in Tanzanian secondary schools. Vavrus and Bartlett (2013) argue that the problem regarding language of instruction in Tanzanian secondary schools could be easily solved, but there is pressure from the international donor agencies, the IMF, the World Bank, and some of the British publishing companies that want English to stay as a language of instruction in Tanzanian post-primary education (Vavrus & Bartlett, 2013). The influence of Tanzanian politicians and the World Bank in the Tanzanian educational system will be discussed further in next the chapter.

Conclusion

This chapter presents the data analysis that answered the research question about whether the colonial legacy still exists in the present Tanzanian educational system. Despite the fact that participants expressed different perspectives on the issue, their opinions and beliefs provide some information as to how the Tanzanian post-colonial educational system is practiced, especially in the governmental

secondary schools. In summary, participants described that the Tanzanian governmental secondary schools have problems. These problems include poor management, corruption, lack of funds, unmotivated science teachers, inadequate science curriculum, low-quality education, and English as a language of instruction. All these problems are described as limiting factors that are preventing Tanzanian secondary science education from developing.

Drawing from these findings, I conclude that the Tanzanian post-colonial educational practices, especially in the science area, have created their own identity. By using post-colonial theory and scientific inquiry theory as an approach to data analysis, the research findings show that the current Tanzanian science education in secondary settings is emerging out of the old system. That means that secondary science curriculum is not 100% conceptualized into the Tanzanian or the African culture and tradition (Mosha, 2000; Semali & Mehta, 2012), nor is it 100% assimilated with the colonizer's (Britain) science curriculum (O-saki, 2007). Currently, science education is still perceived mainly as a process of memorizing facts and figures (Semali & Mehta, 2012), rather than as a questioning process of understanding the natural world (Schiro, 2008; Tobin, 2000). In order to improve the secondary science curriculum, the Ministry of Education needs to create a balanced science curriculum that will honor both Tanzanian science and European science. Merging both ways of knowing could result in creating a powerful curriculum that benefits students, as opposed to the current practice, which provides them with little benefit.

The research findings also show that to some extent the legacy of the colonial

educational system still exists in the current Tanzanian educational system. The impact of English usage in secondary schools is clearly described by some of the participants and some of the existing research as the legacy of colonialism. Additionally, debates surrounding policies regarding language of instruction in Tanzanian secondary schools are politically and economically driven, rather than educationally driven. Currently, there are no empirical studies showing employment benefits for Tanzanian students who are graduating from private secondary schools over the ones graduating from governmental schools. Moreover, studies show that lack of employment for youth and poverty are shared as common problems in Sub-Saharan African nations, despite that fact that students in nations like Kenya and Uganda learn English at all levels of education (Brock-Utne, 2007; Mushi, 2009; Young, 2004).

In order to provide a better education that will open doors to employment for youth and help reduce poverty in Tanzania, I suggest that the nation needs to create a balanced educational policy, as opposed to its current policy which benefits few rather than many. For example, the current policy of instructing secondary students in English is focused on some political and economical biases that seem to benefit a few. Therefore, a new secondary education policy is needed that will honor both Kiswahili and English and will help students enjoy what they are learning in the classroom and enable them to better understand the world around them. I suggest an educational policy that will help secondary students gain better understanding of science concepts. For instance, science subjects can be taught in Kiswahili, which will help students better understand science concepts because they

will be able to make connections between what they are learning in classroom and the world that surrounds them. At the same time, in order to make these students communicate with other parts of the world, I suggest that English must be seriously taught at all levels of education.

CHAPTER 5

Tanzanian Post-colonial Economy, Politics, and Education

In Chapter 2 it is stated that before colonial rule, African people had their own forms of economic, political, and educational systems (Mushi, 2009). These systems were altered during the colonial period when the colonizers introduced their own forms of economic, political, and educational systems (Settles, 1996). It is also described in chapter 4 that the achievement of independence in Sub-Saharan African nations in the last half of the 20th century was a defining historical moment, and people hoped for a bright future life (Young, 2004). Being free from colonial power gave African people a sense of excitement, hope, and anticipation that the struggles of life they endured for centuries would be over. In addition, the new governments promised to abolish the colonial legacy that was characterized by socio-economic inequalities (Moshi, 2009; Samoff, 1999; Young, 2004). In order to eliminate socio-economic inequalities, most new governments, including Tanzania's, sought to restructure the post-colonial educational system according to the native society's structure and culture (Mushi, 2009).

The main focus of this chapter is on the impact of the colonial forms of economic and political systems and how these systems have influenced the way education is provided in Tanzanian governmental schools from the colonial period to the current period. Using post-colonial theory helps us understand the struggles that have been endured by Tanzanians as they work toward socio-economic development within a new form of political and economic structures. This chapter presents three major topics that emerged during the interviews with participants.

The topics include the impact of the colonial economic power on the science education sector, the political influence on science curriculum and training policy in the Tanzanian post-colonial educational system, and the expansion of the secondary education.

The Impact of the Colonial Economic System on Tanzanian Science Education

The colonial economic system has greatly impacted the Tanzanian economy as well as the educational system. During the colonial era, the Tanzanian economy shifted from that of trading goods through a barter system (Settles, 1996) to exporting agricultural and mineral raw materials to Europe (Mosha, 2000; Nieuwenhuis, 1996; O-saki, 2005). Currently, Tanzania is following a free market economic system (Mushi, 2009). The shifting of the economic system, however, has influenced the way education is provided not only in Tanzania, but also in other parts of Sub-Saharan Africa. As noted in Chapter 2, before the colonization period there was a growing industry of smelting metal production, agricultural tools, and weapons in Sub-Saharan Africa (Grieg, 1937; Peter & Child, 1985; Wembah-Rashid, 1973). Economically, people of Tanzania exchanged iron products, spices, beads, and carvings with people from the Middle East, South Asia, and Portugal (Wembah-Rashid, 1973). This form of economy existed for centuries, and it influenced the educational system of that time in that the knowledge and skills that were taught were relevant to and valued by the people (Mosha, 2000; Mushi, 2009).

The colonial economic and the educational system started to be influential in Tanzania after a group of missionary organizations arrived in Tanzania in the 1860s

(Mosha, 2000; Mushi, 2009). These missionaries introduced Christianity along with cash crops such as coffee and tea, which were major raw materials needed in Europe (Mushi, 2009; O-saki, 2005). Missionaries also taught reading, writing, and basic math so that the converts would have the ability to read, write, and comprehend the word of God from the Holy Bible (Mosha, 2000; Mushi, 2009). Mushi (2009) explains more that missionaries paved a way for colonialism by preparing their followers to believe and accept that poverty or any kind of human suffering, such as diseases, hunger, drought, and death, are the will of God. These forms of teaching shaped people's thinking and their acceptance of their suffering (Mushi, 2009).

When the German government established its colony in Tanzania in 1890, the local chiefs and the people who were converted to Christianity easily accepted the implementation of colonial rule and policies in their everyday life (Mosha, 2000; Mushi, 2009; O-saki, 2007; Pandy & Moorad, 2003). Mushi (2009) adds that Germans established a few primary schools in Tanzanian coastal regions that aimed to produce skilled laborers needed in the agricultural processing industries and as low-level clerks. This form of schooling and training policies were carried on by Great Britain from 1919-1961 after Germany lost power during World War I (Mushi, 2009).

Moreover, the Germans and later the British economic principles aimed to link Tanzania with the international economy (Mushi, 2009). The production of cash crops such as coffee, tea, sisal, and cotton as well as the extraction of minerals like gold and diamonds depended on European consumerism (Mushi, 2009). Despite the

fact that Tanzania gained its political independence from Great Britain in 1961, its economic development still strongly depended on the European market (Mushi, 2009). O-saki (2007) also explains that neither the German nor the British colonists were interested in educating workers beyond the level needed to support local agricultural or mining industries; science education that required students' critical thinking to solve real world problems was not developed (O-saki). The lack of major industries to support strong science literacy and innovation had a major impact on the current Tanzanian secondary science education.

Lack of Employment in the Science Field

Even after independence in 1961, Tanzania did not develop major agricultural or mining industries to support strong science innovation (O-saki, 2005, 2007). The lack of major industries in the nation has impacted those students who have opted to study science at secondary and tertiary levels of education. Because of the limited opportunities in the science field, students have to compete for the few available positions in the industrial sectors. They also need to score higher marks in the national examinations if they plan to join the medical field or engineering (O-saki, 2007; Vavrus & Bartlett, 2013). In the current research, participants expressed some concerns regarding the position of science education in the secondary settings. One participant, who is currently a science teacher, said:

> Science is applied in many areas such as the medical field, industries, food service, agriculture, home economics, and countless daily activities. Unfortunately, however, students graduating with science degrees find no job. This situation discourages secondary students

> from majoring in science. I also tell my own children: be practical about future, future, future. The future of science is unknown and uncertain. Scientific subjects are hard and at times consuming. There is no clear employment future for students who are studying science, and the government offers no help despite encouraging students to study science.

This participant's description about Tanzanian science education indicate that the lack of employment for scientists is one of the factors that currently should discourage students from pursuing science education in post-secondary education. The fear of unemployment in the science field is discouraging parents from supporting their children in the study of science. This lack of employment in the science field has also been found in Uganda. Uchida (2009) describes that there is a large number of youth in Uganda who are interested in science and technology, but the employment rate of students who graduate in this area is low. Like Tanzania, Uganda lacks major local industry that can provide employment in the science field. What is available in these countries are foreign-invested, middle-sized companies that look for cheap, and unskilled, laborers (Uchida, 2009).

Besides lacking local industries in the Sub-Saharan nations, scholars also argue that science that is learned in schools in most of these nations is not useful. This is because most science content was adopted from the colonial science education and has never been modified according to African economic needs (Mosha; 2000; Nieuwenhuis, 1996; Shizha, 2010; Uchida, 2009). For example, in Tanzania secondary science education still reflects the colonial curriculum (O-saki,

2007). The issues regarding the Tanzanian secondary science curriculum will be further discussed in Chapter 6.

The Lack of National Priority in the Science Field

As described in the previous chapter, when Sub-Saharan African nations gained political independence from their colonizers, the new nations inherited many socio-economic problems (Mushi, 2009; Samoff, 1999; Young, 2004). People were living in extreme poverty, where ignorance, hunger, and disease prevailed. In addition, people were exploited (Kassam, 1994; Mushi, 2009; Nieuwenhuis, 1996). Mushi (2009) describes further that the problems inherited from the colonizers presented major challenges because every problem needed some attention. People also expected much from the government (Mushi, 2009). Consequently, it was hard for the new nations to prioritize the problems in education and ignore other social services, such as medicine and food. Trying to solve many problems at once has caused science and technology in Sub-Saharan African nations to develop slowly (Mushi, 2009). Although Tanzanian leaders emphasize and address the need of scientists in the country, their actions do not seem to match the reality at the ground level. Discussing with participants the need of science experts in the country, one from the administrative office stated:

> The problem is not science experts. We have enough experts who have been trained within and abroad. But the problem is the lack of advanced tools that can enable them to do their jobs. For example, we have trained doctors who are experts in complicated medical issues such as heart problems, but they cannot perform heart surgery

> because our hospitals do not have the right equipment. So, people have to access treatment outside the country, like in India or South Africa.

The interviewer asked: "why is that?" The participant responded:

> The issue is one of priority. You know, when you are poor, everything becomes priority to you. In this county, every sector such as education, health, agriculture, and other services deserve priority. You cannot deny people's social service and spend the money on medical's sophisticated equipment.

The participant might be correct that being poor can cause individuals or a nation to lack a specific priority. But it is also important to recognize that having specific priorities and focusing on those priorities can redeem the person or a nation from poor conditions. The lack of funding and prioritization has affected not only medical field development, but also other fields, such as science and engineering. One participant explained further:

> The Tanzanian government still imports infrastructure contractors from China, Japan, and from Western nations. Local engineers are not given priority. For example, many graduates in engineering are either employed by foreign investors as cheap laborers, or they look for employment in neighboring countries, or they change careers.

Participants' argument about priority given to foreign investors is supported by Uchida's (2009) study project. Uchida describes that most of the Sub-Saharan African governments give priority to foreign engineers who have funds from their

mother nations; as a consequence, local engineers are employed by those foreign engineering companies as cheap laborers (Uchida, 2009). In order to change the current situation, there is a need for the Tanzanian government, the Tanzanian Ministry of Education and Vocational Training, and the Tanzanian Educational policymakers to create a focused purpose of providing science education in schools. Having a focused training policy in the science field could make science education stronger and could produce more expertise in both the science field as well as the engineering field. In addition, the government needs to give the available local scientists and engineers priority and support and provide them with resources they need to perform their work and use their expertise for the benefit of Tanzanian society. It is a waste of money and time to train individuals in a certain field and then not give those individuals a chance to practice what they have trained for. Moreover, promoting local scientists and engineers may in turn increase employment in the science field and also could attract more youth in the field. The following section discusses how the colonial political system has influenced the Tanzanian educational system from the colonial period to the present time.

Political Influences in the Tanzanian Educational System

As noted in Chapter 2, before the colonization period Sub-Saharan African people lived in small communities. These communities were identified in three categories, including communities ruled by chiefs, those ruled by kings, and those following an empire system. All three groups had their own form of political system (Settles, 1996). Education was conducted traditionally, and the whole society was responsible for or participated in their children's education (Mosha, 2000). The

education was holistic; it considered mind, body, and spirit (Mosha, 2000). Because it was a cooperative form of education, there were no ministries of education, classrooms, or national exams. Every tribe or clan educated its youth according to its culture and social practices (Mosha, 2000; Mushi, 2009).

These forms of political and educational systems were altered during the colonial period (Settles, 1996). The colonizers introduced a hierarchical form of government that was also in charge of the educational system. Therefore, these new forms of government and education took away the power of parents and other members of families and clans from participating in their children's education (Mosha, 2000; Mushi, 2009). In other words, the colonial government had the power to decide what students should learn in school without involving parents or other community members (Mosha, 2000).

Politicians' Control over the School Curriculum

It is described by Mushi (2009) that after the colonial rule some of the Sub-Saharan African nations, including Tanzania, reformed their educational system. However, the school hierarchical structure was maintained (Mushi, 2009). Local political leaders remained decision-makers regarding educational policies and the school curricula. The role of teachers, students, parents, and other members of the community in processing the school curricula and school policies remained limited (Mushi, 2009). Mushi also describes that since the independence period in 1961, Tanzania has undergone major and minor educational reforms, which include the Education for Self-Reliance Philosophy, the Science Inquiry Curriculum for secondary schools, the Nuffield School Science Project, and currently the Learner-

centered Curriculum. These reforms, however, have failed because the reform processes do not involve educational officials, teachers, parents, and other members of the community (Mushi, 2009). Participants in this research described that over control by politicians in the Tanzanian system has resulted in major consequences affecting the relevance of the education offered. Making decisions or changing the educational curricula without involving teachers and other school stakeholders has affected students' academic achievements. One participant explained that:

> Politics has played a major part in making the Tanzanian education to be like it is. First of all, most of the politicians who minister the educational sector are not educators by profession. After these individuals are appointed as ministers and get into office, they start making all kinds of decisions concerning educational issues without involving educators. For example, we have witnessed some of the educational ministers ordering curriculum changes without involving school stakeholders like teachers, parents, and educational administrators. This kind of leadership has led teachers and students to become victims of the educational sector because whenever students score poorly in the national exams, society blames teachers for failing students. Also students who score below average are completely eliminated from the educational system.

From the participant's description, it shows the top-down approach that has been used by politicians to administer the educational system, which has created problems in students' academic achievement. That type of problem can be solved or

reduced if the politicians and educators could learn to work together as a team for the benefit of the students. Studies suggest that collaboration between leaders and educators could produce successful change (Fullan, 2001; Shkedi, 2006). Fullan (2001) argues that changes cannot be successful if the teacher's role is only focused on classroom activities. Teaching is more than the activities defined within the classroom walls. In other words, teachers should be partners in the process of curriculum change, and they should be given an opportunity to participate in the curriculum process before the actual classroom implementation (Fullan, 2001). In other words, teachers should be given the opportunity to have input during the initial curriculum development process. Shkedi (2006) also suggests that curriculum is more than simply following the existing curriculum, and innovation is not about putting into place the curriculum. Changing curriculum means changing the cultures of teachers, classrooms, and schools. Therefore, the role of teachers in the process of curriculum development is crucial (Shkedi, 2006). In general, successful changes in the Tanzanian education system could be reached if the national leaders, teachers, parents, educational professionals, and other school stakeholders learn to work together toward a single goal. That goal would be to improve the educational system.

The Expansion of the Tanzanian Governmental Secondary Schools

In this study, participants described that there is unbalance between the education quality and the quantity. That means both the number of secondary schools and the students' enrollment have been increased, but the quality of secondary education is very low. Most of the participants explained that, despite the

fact that the number of youth attending secondary schools has increased, these students are not exposed to quality education. Currently, most of the governmental secondary schools do not have qualified teachers or even enough teachers. In addition, the schools do not have enough resources and standard school facilities such as libraries and science laboratories. One of the participants explained:

> The problem we have in this country is that the Ministry of Education has not yet invested in quality education. They are unconcerned about what students learn in school. The Ministry is more concerned about school enrollment, and they are working hard to make sure that every school age child is in school. But they do not consider other issues like providing quality education once students are there. Maybe they are working on it, but they have not yet succeeded.

Another participant described:

> The government is a problem. For example, years ago there were few schools and teachers were motivated. The situation changed, because there started to be a time when the government received money from international donors and that money was intended for educational improvement in the country. It seems that the prime minister at that time sat down with a few people and decided to start community secondary schools. To initiate that, communities were asked to work together to build schools with a little help from the government. Thousands of secondary schools were introduced all over the country, and students were enrolled. Consequently, there were neither enough

> teachers nor learning resources for these schools. Adding to that, the newly built schools are poorly constructed without science laboratory facilities and libraries.

Participants' discussion about low quality of education in Tanzanian governmental schools is also found in other studies. Mushi (2009) explains that Tanzania has increased student enrollment in both secondary and tertiary education levels, but the quality of education provided is very low. Also, data from the Tanzanian Ministry of Education and Vocational Training (MoEVT) website shows that secondary students' enrollment has increased from 675,672 in 2006 to 1,638,699 in 2010, and the higher education enrollment in universities and colleges has increased from 40,993 in the 2005/2006 school year to 118,951 in the 2009/2010 school year (MoEVT, 2012; Mushi, 2009). The 2012 survey conducted by MoEVT indicates no significant improvement in terms of students' academic achievement beyond that of increasing the number of secondary school facilities and student enrollment.

Teacher-Student Ratio

The increased number of student enrollment in secondary schools has had an impact on teacher-student ratio. Although Tanzanian government secondary schools have a history of overcrowded classrooms (Nieuwenhuis, 1996; O-saki, 2005), currently the problem has worsened, especially in science classrooms. Participants in this research described crowded classrooms as a major limiting factor for teachers to meet students' learning needs. One participant said:

> There are too many students in a classroom. Instead of teaching 20 or 25 in a class, you find that all the classes have more than 70 students. This is a major problem. You know it is necessary to give them practical work, but it is impossible to do so often enough. If you have a few students in your classes, you can reach them easily, and you can ask each student to solve problems. In the current situation, it is very difficult to meet the standards.

Another participant said:

> The number of students in a classroom is too large. For example, introductory chemistry has more than 200 students per section. Imagine such a number at upper levels, say in fourth year. How can one teacher manage to provide laboratory work for such a large number of students? Such a situation is very difficult and challenging not only for science teachers, but also for students.

As participants described the problem of having a large number of students in a classroom, the researcher also observed that during laboratory work, teachers were unable to look at all students' work. Students were provided with hands-on activities, but teachers were unable to provide them feedback. The following paragraphs describe what the researcher observed in the physics practical lesson.

> It was May 16th in the afternoon when the first students had a physics lab work period. In the laboratory there were three concrete rectangular tables. The laboratory room has no gas, running water, or electricity. At the beginning of the lab period, the teacher did provide

> a brief overview about the lesson's topic, which was about "Relative Density." The major emphasis was on how to write a formula with the International System of Units (SI units), and how to calculate the experimental data and to record that data on the experimental data sheet. The teacher also demonstrated how the experiment would be carried out. After the demonstration, students were grouped into nine groups, each with eight students. Then, each group was called to collect the materials needed for the experiment. The class was too noisy, and the teacher spent much of time shouting, "Class quiet, quiet class." In addition, the teacher was a so busy helping students with a beam balance at the front table, he did not get a chance to look at students' work. Five minutes before the end of the class period, the teacher asked each group to write down the experimental calculation results on the blackboard. Some of the groups' answers were close to the teacher's answer, and other groups had either bigger or smaller numbers than was expected. Then the teacher told the students to copy the right answer into their notebook. There was no time for students' discussion, brainstorming, or a time for a teacher to ask students questions about the experiment.

This form of teaching and learning clearly shows that even if students are given some hands-on activities, the scientific inquiry learning process is not present. While it is important to recognize that the Tanzanian government is doing an important job to increase the enrollment for secondary students, it is also vital to

notice that sending more students to school without considering the quality of education also has some negative consequences. Mushi (2009) describes that despite the fact that more and more youth are receiving secondary education diplomas, these youth are having a hard time finding jobs because they do not have enough qualifications. In order to change the current situation, the Tanzanian Ministry of Education and Vocational Training needs to create a balanced educational policy. This means that the policy has to consider both education quantity and quality.

Conclusion

This chapter analyzed the issue of post-colonial economics and politics in the current Tanzanian educational system. The chapter discusses the problems related to lack of employment in the science field and the lack of national priority in relation to science education. Further, the contributions of local science experts have been overlooked, as has been the issue of teacher-student ratio in relation to scientific inquiry. Moreover, the issue surrounding providing low-quality education to students and the over control of the school curriculum by politicians are described as major issues and problems in Tanzanian secondary science education. In order to improve secondary education in the Tanzanian governmental secondary schools, especially in the science area, I suggest that collaboration strategies should be the number one priority. This means that Tanzanian politicians, educators, parents, and other school stakeholders have to learn to work together for the benefit of quality education in the nation. In this study, participants describe that politicians, especially those selected by the Tanzanian president to oversee the Ministry of

Education, make decisions on school curricula and on school expansion without involving educators, parents, and other school stakeholders. I suggest that since politicians do not often hold on their positions for a long time, it is vital to to involve teachers, parents, community members, and other educational stakeholders in decision-making in the educational system.

CHAPTER 6

Secondary Science Curriculum, Teaching and Learning Pedagogy

In the previous two chapters, the researcher analyzed the issue of the colonial educational system and its legacy on the current Tanzanian educational system. Chapter 4 discussed the issues surrounding Tanzanian post-colonial educational practices. These issues include corruption, poor management, and inadequate science curriculum. Chapter 4 also analyzes some of the controversial educational policies that were adopted following Tanzanian independence in 1961. One of these policies is the use of English as the language of instruction in secondary schools. Chapter 5 discussed the impact of the colonial economy and politics in the Tanzanian post-colonial educational system. Chapter 5 also discussed the influences of local politicians and international organizations in the current Tanzanian educational system. This chapter focuses on the pedagogical paradigm issues that were discussed by participants as limiting factors for implementing science inquiry in Tanzanian governmental secondary schools. The major issues discussed in this chapter include the learner-centered science curriculum for secondary schools, school facilities and learning environment, teachers' compensation, and teacher professionalization/professionalism. These four themes emerged from participants' discussion during the interview process.

Tanzanian Secondary Learner-centered Science Curriculum

As noted in Chapter 2, in 1967 Tanzania introduced a new educational policy known as "Education for Self-Reliance" (ESR). The major vision of that policy was to

promote a teaching and learning environment that would develop students' critical thinking and self-confidence (Kassam, 1994; Kitta, 2004; MOEC, 2001; O-saki, 2005, 2007). Unfortunately, the science inquiry program in the Tanzanian governmental secondary schools was discontinued in the 1970s due to several reasons, including the increasing number of secondary schools, lack of science teachers who were trained in scientific inquiry, and a lack of teaching and learning resources (O-saki, 2007). In addition, the implementation of the Education for All (EFA) policy in the 2000s has forced the Tanzanian government to expand the secondary education sector (Mush, 2009). As a result of these factors, the problems of teacher shortages, overcrowded classrooms, lack of teaching and learning resources, and lack science laboratories and libraries have been heightened (Mabula, 2012; O-saki, 2007; Semali & Mehta, 2012).

Despite all of these struggles, the Ministry of Education has ordered the Tanzanian Institute of Education to design a new secondary science curriculum that emphasizes students' competence as opposed to a traditional curriculum (MoEVT, 2005, 2010). Competence-based curriculum is sometimes defined as learner-centered curriculum or learner-centered pedagogy (Ramsey & Choi, 2009; Schiro, 2008; Vavrus & Bartlett, 2013). This new curriculum was published in 2005, and all secondary schools were required to implement it. In this study, the researcher opted to use the term learner-centered curriculum instead of using the term competence-based curriculum. The term learner-centered curriculum is more present in the educational system worldwide than the term competence-based curriculum.

It is described by Vavrus and Bartlett (2013) that the adoption of the learner-centered curriculum in Tanzanian secondary schools came from the UNESCO framework. This framework emphasizes a child-friendly learning environment, as opposed to a teacher-centered learning environment. The pedagogical shift toward a learner-centered approach in Tanzania is also manifested in the expectation that secondary school graduates would be enabled to become self-employed (MOEC, 2001). Therefore, the major focus of the curriculum is on students' acquisition of skills and critical thinking development (MoEVT, 2005, 2010; Vavrus & Bartlett, 2013). Before discussing the problems and issues surrounding the implementation of the curriculum in Tanzanian governmental secondary schools, it is important to redefine learner-centered curriculum.

What is Learner-centered Curriculum?

Theoretically, learner-centered curriculum is rooted from a constructivist idea that describes how individuals acquire knowledge from their surrounding environment (Philips, 2000; Schiro, 2008). Constructivist theory has its primary roots in the work of Lev Vygotsky, Jean Piaget, and John Dewey. The main purpose of learner-centered theory is that learning is a function of the interaction between people and their environment (Schiro, 2008). This means that learners acquire knowledge either through interacting with experienced people or from the environment they encounter every day (Schiro, 2008). Furthermore, Schiro explains that people are not passive agents during their interaction with the environment; people are active agents of their own learning. Therefore, learning is not something transferred from the environment to people, but something created

by people in response to their interaction with the environment (Schiro, 2008). In short, the learner-centered curriculum is a type of curriculum that focuses on students' knowledge acquisition from surrounding environments as well as from life experiences.

Problems Surrounding the Science Learner-centered Curriculum in Tanzanian Governmental Secondary Schools

The introduction of the learner-centered science curriculum in Tanzania should be considered one of the important steps toward the improvement of science education in its secondary schools. However, recent research findings show that the learner-centered science curriculum in Tanzanian secondary schools is actually present in curriculum guides, such as syllabi books, but it is hardly practiced in classrooms (Mabula, 2012; Semali & Mehta, 2012). Participants in this study also described that implementing the learner-centered curriculum in the Tanzanian governmental secondary schools is difficult. This is because these schools have several problems, including the following: lack of teaching and learning resources, inadequate school facilities, lack of motivation for science teachers, and poor training policy. One participant who is currently working in administration described:

> The introduction of learner-centered science curriculum in secondary schools is one of the science education improvements. This is because the curriculum aims to help students to be independent. The learner-centered approach is also re-emphasizing the Self-reliance Training Policy, which we have been using since the 1960s. However, what

> matters the most is its implementation. Firstly, most of the governmental schools do not have qualified teachers and school learning facilities such as science laboratories and libraries. Secondly, we do not have a clear training policy that channels job opportunity for graduates. Thirdly, the current education and training policy does not promote students' attitude toward self-employment. I think that more effort and input from the government and private sectors are needed to play a part in this curriculum issue.

Another administrator explained science teachers' lack of motivation:

> The new student-centered curriculum is not the problem, but the implementation of it is. The reason I say this is that we need to look at the individuals who have to do the implementation and ask ourselves some questions: Are the individuals who are supposed to implement the curriculum prepared to do so? Are they motivated? It is possible to have a wonderful and well-organized curriculum and still change nothing, if teachers are not motivated?

From the participants' perspectives, it seems that the curriculum itself is not an issue. The major issues are around the science teachers themselves, as well as the secondary education training policy. While there is truth in this situation, studies of Tanzanian secondary science curriculum also show that despite the fact that the learner-centered approach is emphasized, the science content within the curriculum is still irrelevant to students' everyday life practices (Mabula, 2012; Semali & Mehta, 2012). In other words, the Tanzanian secondary science curriculum has a collection

of science facts that are not relevant to students (Semali & Mehta, 2012). In addition, the secondary science curriculum is over-loaded with content, giving teachers insufficient time to teach it all (Mabula, 2012). As a result, the teaching and learning practice focuses on finishing syllabi rather than on understanding the concepts of the scientific theories and practices (Mabula, 2012; Semali & Mehta, 2012).

In addition to the curriculum being overloaded with information, the curriculum was also described as inconsistent. Participants in this research noted that the secondary science curriculum has been changed often, and none of the changes have produced positive impacts on students. Moreover, the reform of the learner-centered curriculum is still unclear because most of the school stakeholders, such as teachers, students, and parents, are not familiar with the changes. One participant who is currently an active teacher explained:

> I'm not sure if the new curriculum could be implemented for a long period of time. This is because the curriculum has been changed back and forth. For instance, there was a time when physics and chemistry were combined and were taught as a single subject. Shifting from teaching chemistry and physics as separate subjects to teaching chemistry-physics as a single subject was very hard. Teachers were not prepared for it. It was also hard to find a combined definition that could include what is physics-chemistry. After a few years, we went back to the previous practice. This makes me wonder whether the learner-centered curriculum will be practiced long enough to produce

> positive results. After a few years we will go back to the teacher-centered curriculum?

Another participant, an administrator, said:

> The reform of the learner-centered science curriculum is still unclear, and most of the school stakeholders, such as teachers, students, and parents, are not familiar about these changes. Only a few individuals at the administrative level decided to change the curriculum without even considering how it would be implemented into classrooms.

It was described in Chapter 5 that Tanzanian politicians control school curriculum reform. Consequently, these types of reform have never been implemented in the classroom because those charged with implementation are excluded from the reform process. Participants' descriptions of the exclusion of teachers and other school stakeholders agree with Fullan's (2001) and Shkedi's (2006) finding that authorities around the world tend to view the role of teachers as limited to classroom practice. Fullan (2001) argues that changes cannot be successful if the teacher's role is only focused on classroom activities. Teaching is more than the activities defined within the classroom walls (Fullan, 2001). In other words, teachers are partners in the process of curriculum change, and they should be given an opportunity to participate in the curriculum development process before the actual classroom implementation (Fullan, 2001).

Shkedi (2006) also suggests that changing curriculum is more than simply the handing down of the curriculum by the authority. Changing curriculum means changing the culture of teachers, classrooms, and schools. Therefore, the role of

teachers in the process of curriculum development is crucial (Shkedi, 2006). In order for changes to produce positive results, the Tanzanian authorities that are in the position of reforming the curriculum have to collaborate with teachers and other school stakeholders. It seems that there is a lack of collaboration between the Tanzania Institute of Education, which is in charge of developing the curriculum materials, and the Tanzanian Examination Council, which is in charge of preparing the national examination materials. Since these two departments work independently, classrooms practices are likely to focus on what students are tested on in the national examinations. Consequently, the implementation of the reformed curriculum is compromised. Discussing the connectivity of the secondary science curriculum, its assessment, and the reality of it in classroom practices, one participant, an administrator explained:

> Personally, I see that the Tanzanian curriculum reforms in the science area have not yet enabled science learners to apply science knowledge into daily activities. We are now singing this song of learner-centered curriculum, but there is nothing happening in the classroom. Teachers are still using the teacher-centered method, and schools are still using the same assessment model.

The participant's experience with the current Tanzanian secondary science curriculum clearly shows that there are some issues separating the implementation of the curriculum materials and the school assessments. The current students' academic assessment does not favor the learner-centered curriculum. As a result, teacher-centered curriculum is still implemented in science classrooms. The science

questions that are offered during the national examinations do not favor the learner-centered curriculum. The designs of national examination questions show that students are required to memorize science facts, definitions, and formulas. For example, the materials on the 2010 biology national examination paper show that students were asked to recall names of specimens and to draw and label some important parts of the specimens. One of the exam's questions states, "Carefully observe specimen D1 and answer the questions which follow: (a) draw and label specimen D1, (b) to what kingdom and phylum does the specimen belong?" These types of questions seem to encourage remembering and memorization rather than critical thinking. It is also likely, therefore, that classroom teaching and learning practices would need to reflect the types of questions that are asked on the national examinations if a student is to be successful.

The researcher in this study also learned that not only do the examination questions emphasize the memorization of facts and definitions, but also the newly reformed secondary science curriculum still has some weaknesses. For example, the syllabi for physics, chemistry, and biology promote reflective learning, but the predetermined teaching and learning objectives in those syllabi still focus on remembering science facts. In other words, the teaching and learning objectives do not offer an opportunity for students to reflect on the scientific theoretical content that relates to their cultural practices. In addition, the assessment section shows that the teachers' role is to make sure that students are competent in describing, identifying, explaining, measuring, and defining science facts (MoEVT, 2005, 2010). This type of teaching and learning approach clearly shows that despite the fact that

the new science syllabi are titled for a learner-centered curriculum, the inquiry science teaching and learning process is not available.

The lack of inquiry in science teaching and learning was also observed at the school where the researcher observed classroom activities. The following paragraphs describe the pedagogical practices in the science classrooms during classroom activities:

> It was May 15th in the afternoon; the researcher conducted a classroom observation in a physics class lecture. This lecture was for first-year secondary students. Before the class period, the physics teacher asked the researcher to introduce herself at the beginning of a class; the researcher agreed. When the researcher entered the classroom, all students stood up and greeted at once;
>
> Students: Good afternoon madam
>
> Researcher: Good afternoon; how are you?
>
> Students: We are fine madam.
>
> Researcher: Please be seated.
>
> Students: Thank you madam.
>
> Researcher: My name is so and so… I am a student at the university… and I'm here today to learn physics with you.
>
> Student: Welcome madam.
>
> Teacher: Student, give madam a place to sit.
>
> There was an empty chair and a desk at the back, and that is where the researcher sat down. After this introduction ceremony, everybody

sat down quietly, except the teacher. On the blackboard, there was a thick chalk highlighted sentence that stated “Relative Density.” Then the lecture started as follows:

Teacher: Last week you learned about density. What is density?

Students: Density is equal to mass over volume.

Teacher: Who can write the formula of density and its SI unit on the blackboard?

Student1: ρ= M/V

Teacher: Is that correct?

Students: No

Teacher: Who wants to make some corrections?

Student2: ρ= M/V; g/cm3

Teacher: Is that correct?

Students: Yes

Teacher: Students, make sure when you write down the formula, also remember to write down the SI units. This is because if you do not write down the SI units in your examination, you will lose points.

After this short revision, the teacher spends a few minutes explaining the meaning of Relative Density. The major emphasis was on definition, formulas, the SI units, and calculations. Ten minutes before the end of class period, the teacher wrote on the blackboard two sample questions related to the relative density topic, and students

were asked to calculate and provide answers. Students were asked to copy those questions into their notebooks.

In that 40-minute class period, there was little interaction between the teacher and students. Although the new physics syllabus is directing the teacher to assist students in describing the concept of the relative density of a substance, real classroom practices do not reflect what is stated in the syllabus. Similar teaching and learning strategies were also observed in chemistry classrooms. The emphasis on formulas, definition, drawing, and labeling diagrams was greater than the emphasis on understanding the concept of the topic. The following paragraphs describe what was observed in the chemistry laboratory class period:

> It was Friday morning when the chemistry practicum was offered to first-year students. The subject topic was "Heat and Flame." In the lab room, there were four long concrete rectangular tables arranged in rows, and on each table there was one burning candle and one medium-size tank stove. Students were told to form groups of six. Each table had three groups. The teacher started the class lesson with a question:
>
> Teacher: What are the sources of heat you know from home?
>
> Student 1: Candles
>
> Student 2: Charcoal
>
> Student 3: Firewood
>
> Student 4: Stove

Teacher: Very good. Then the teacher told students to clap for those who answered the question.

After that short introduction, the teacher started to demonstrate the experiment. Students were asked to observe the burning candle and then describe the flame's characteristics. A few students had the chemistry lab manual, and the other students used their chemistry notebooks. These latter students were observing the candle's flame and at the same time looking at the flame's diagram in their books or in their notebooks. After a few minutes of observation, the teacher wanted students to participate by drawing and labeling the flame on blackboard.

Teacher: I want two volunteers to draw and label the flame on blackboard.

Two girls chose to volunteer. But one of the girls did not label the diagram correctly.

Teacher: Which diagram is not labeled correctly?

Students: The one on the right side

Teacher: Who wants to re-label the diagram? One student volunteered.

Teacher: Is that correct?

Students: Yes.

After observing and labeling the candle's flame, the teacher turned on the tank gas stoves, and students were again asked to observe the

> parts of the flame, and then two students were asked to volunteer for drawing and labeling. Then the class period was over.

Neither the students nor the teacher asked more questions other than the one that was asked at the beginning of the class period. This type of classroom practice clearly demonstrates that inquiry science pedagogy is hardly applied in this Tanzanian governmental school. This data finding supports the research findings by Mabula (2012), Semali and Mehta (2012), and O-saki (2007) that the pedagogical process in the Tanzanian governmental secondary science classrooms focuses more on remembering formulas and labeling diagrams. Scientific inquiry is not practiced.

The issues regarding secondary science curriculum and pedagogy have also been found in other Sub-Saharan African nations. Brock-Utne (2013) and Semali and Mehta (2012) describe that the teaching and learning of science in most of the African nations focuses only on understanding scientific content, rather than on understanding science concepts. Semali and Mehta also add that African science curriculum planners continue to struggle with the tension of colonial legacy, in which science education focused more on preparing technicians as opposed to preparing people with genuine scientific inquiry. As noted in the previous chapter, during colonialism science was introduced in Tanzanian schools with the purpose of preparing technicians. These technicians were required to work with simple machines in the agricultural processing industries (Kitta, 2004; O-saki, 2005, 2007). It is evident that this type of training purpose still exists in the African post-colonial educational system. Consequently, science education in secondary school has only been perceived as preparation for students who want a career in medicine,

agriculture, or engineering (Vavrus & Bartlett, 2013). This kind of perception could limit students who are not interested in actual careers in these fields, but are looking for useful scientific knowledge. In other words, this situation limits the overall development of science literacy in African society.

School Facilities and Learning Environment

Good school facilities and standard learning environments are considered important for students' academic achievement (McGuffey, 1982). However, substandard school facilities and a poor learning environment have not only negative impact on students' academic achievement, but also on teachers' performance. Corcoran et al. (1988) describe that a poor working environment and substandard school facilities influence teachers' effectiveness and job satisfaction. In the case of Tanzania, school facilities and learning environment conditions in the governmental secondary schools are currently challenging. Participants in this study described that most of the governmental schools have serious problems. These include a shortage of qualified science teachers and a lack of libraries and science laboratories. Teachers' living conditions and distance from school, especially in rural areas, are also raising major concerns. One participant, a science teacher, described:

> From my experience, fruitful learning depends on the quality of the school facility and the school environment. But, most of the secondary schools have no appropriate laboratory equipment for science practice; instead, students are using inadequate equipment. Although they are getting the idea of the subject, they cannot observe

> the reality. The major challenge is that students feel like they are cheated from seeing the real concrete reality. Consequently, they do not like science subjects. Beside that, most students in rural areas have to commute for about two or more hours to reach their schools. They get there very tired and exhausted.

This participant's explanation about the learning environment conditions in Tanzanian governmental secondary schools is line with what was described in Chapters 1 and 2; that is most of the governmental secondary schools, especially in rural areas, lack necessary school resources like desks, laboratories, libraries, and teacher housing (Mushi, 2009; O-saki, 2005; Shayo, 2010). Existing studies show that the problem of poor learning environment conditions, especially in science classrooms, has existed since the late 1960s (Mushi, 2009; Niewenuis, 1996; O-saki, 2007). In the late 1960s and the early 1970s, the Tanzanian government established more primary and secondary schools, but it did not have enough funds to support the schools (O-saki, 2007). Since then, the poor learning environment and lack of funding in the governmental schools have been the norm. This situation, therefore, is an obstacle for implementing a learner-centered curriculum.

Mabula's (2012) research findings also show that most of the governmental secondary schools have maintained the teacher-centered approach because schools do not have learning resources necessary for the learner-centered approach. His findings support the writing of Schiro (2008), who states that a learner-centered curriculum is rarely implemented in schools with limited teaching and learning resources. If the Tanzanian Ministry of Education is really committed to promoting

the learner-centered curriculum in secondary schools, the improvement of the learning environment has to be a number one priority. This improvement can only happen if politicians, educators, parents, and other school stakeholders collaborate and work together toward the goal of school improvement. This improvement will need to include better school management and a good school funding strategy, as opposed to the current funding strategy, which relies on the annual government budget and international donor agencies. Developing a new strategy for school funding and improving school management could transform the current substandard school facilities and the learning environment as well.

Teachers' Compensation

Teachers' compensation is another topic that was discussed during the interview process. The participants of this study described that teachers' salaries are very low. In addition, teachers do not receive employee benefits, such as sick days and vacation days. Moreover, novice teachers do not get immediate pay from the Board of Education, especially during the first few years of their teaching career. Teachers' equal pay policy was also described as a major factor that is discouraging science teachers from investing extra time with students. One participant, an administrator, said:

> I am not satisfied how science teachers are treated. First of all, science teachers' salaries are very low when compared to other traditional professions like medicine and law. Secondly, there are no financial motivations for science teachers in the government schools, because there is no payment for overtime. As a consequence, no parents want

> to send their children to government schools; education there is not adequate. Personally, I send all my children to private schools because in private schools teachers are well supported and motivated.

The participant's description of teachers' compensation shows that the lack of motivation, support, and salaries for science teachers have discouraged them from fulfilling their teaching responsibilities. In addition, another participant, a science teacher, went further to explain the impact of the teachers' equal pay policy on science teachers as follows:

> There was a time when science teachers' salaries were more than other teachers. Now, I do not know why they decided to equalize payment for all teachers. This policy has discouraged science teachers from spending extra time with students or giving them lab work. It does not make real sense to demand science teachers to spend extra hours preparing and doing laboratory work while still paying them equally with other teachers whose subjects do not require lab work.

Another teacher described:

> Science teachers have been overworked and are not paid accordingly. Generally, every teacher is supposed to teach a minimum of twelve periods per week. For science teachers, that number of periods is doubled because of lab work; and labs consume more time than lecture.

The problem regarding teachers' compensation in the Tanzanian governmental schools is not something new. Research findings show that since the 1960s, teachers

have been struggling to survive on low salaries. Consequently, it has been difficult to attract or to retain qualified science teachers (O-saki, 2007). Currently, the situation has worsened because the cost of living has increased when compared to the 1960s. In their research, which involved interviewing science teachers about teachers' work and working conditions in the northern part of Tanzania, Frances Vavrus and Lesley Bartlett (2013) found that Tanzanian science teachers are overworked. Teachers complained that their salaries do not allow them to provide for themselves and their families. In order to support their families, they have to take on other jobs to boost their income. Some of them decide to leave their teaching career completely (Vavrus & Bartlett, 2013).

Besides the low salaries and lack of support and motivation for veteran science teachers, novice teachers are not well supported in the governmental secondary schools. It was described by participants in this research that when novice teachers are hired, they do not get immediate financial support, especially during the beginning of their employment. This situation causes them to be ineffective. Describing novice teachers' working conditions, one participant, an administrator, said:

> Generally, I can say that novice teachers start their teaching career with enthusiasm and determination, but the working conditions do not support them. For example, a newly hired teacher can stay up to three months without receiving any salary or any pocket money to support his/her living expenses. Then, this teacher starts planning how he/she is going to survive. The easy solution for him/her is to

> look for alternatives, such as getting a part-time job at a private school or a job at a tutoring center. When these teachers start having two or three jobs, it becomes more difficult for them to be effective in their first employment. And that is a major challenge in the government secondary schools.

Data from this current research, together with data from Vavrus and Bartlett (2013) and O-saki (2007), shows that it is clearly evident that Tanzania has a way long to go in order to provide quality science education in governmental secondary schools. There is a need for the Tanzanian Ministry of Education to look for new possibilities that would somehow improve teachers' compensation by paying them according to their services. Improving teacher salaries and other benefits would help maintain qualified science teachers in schools and attract more qualified individuals to teaching careers. This move could also help to improve teacher professionalism, which is currently a challenging issue in the Tanzanian educational sector, as described in the next section.

Teacher Professionalization and Professionalism

Teacher professionalization and professionalism are also issues of concern in the Tanzanian educational sector. The most challenging issue is the current teacher professionalization program for pre-service teachers. Teacher professionalization can be defined as pre-service teacher entry requirements, licensing practices, and certification (Kubow & Fossum, 2003). Research findings indicate that the Tanzanian teacher training policy welcomes teacher candidates who have minimum scores in their national examination results. In other words, students who do not

qualify to join the medical fields or engineering fields are selected to join teacher-training colleges (Mushi, 2009; Semali & Mehta, 2012; Vavrus & Bartlett, 2013). Participants in this research also described that the Tanzanian teacher training policy does not attract qualified candidates; the policy has focused on training candidates who score average on the high-stakes national examination. Consequently, a teaching career has been perceived as a second-class career, which is the opposite of other traditionally professional careers, such as medicine, engineering, and law. One participant, an administrator, said:

> Personally, I can say that a teaching career needs to have more respect. By respect I mean that those who are selected for teacher training should not be ones who score below average in the national examinations. Teachers are the cornerstone of a good academic foundation for primary students, which is essential for continuing secondary educational success. Therefore, prospective teacher candidates should be very bright. Training below average candidates in teacher colleges has demoralized the teaching career sector because many people now view a teaching career as a career for failures. I think that we can do better if we can change the teacher training policy in our educational system.

This participant's explanation of the Tanzanian teacher training policy clearly shows the weakness of teacher professionalization in terms of pre-service teacher entry requirements. In addition to the minimum entry requirement, the training duration and the way teachers are trained also contribute to the problem. Vavrus and Bartlett

(2013) and Lewin and Stuart (2003a) describe that the pre-service teacher training policy in Tanzania and in other Sub-Saharan African nations have competing demands on the curriculum. The syllabi are overloaded with content. Also the pedagogical process is that of transmitting particular subjects' content without teaching how to integrate theory and practice (Lewin & Stuart; Vavrus & Bartlett).

Other studies also show that there is a contradiction between the teacher training approach and the establishment of the learner-centered science curriculum in Tanzanian secondary schools, an approach that requires teachers to create a science inquiry teaching and learning environment (MoEVT, 2005, 2010). Currently, not all teacher colleges in Tanzania are training teachers in the inquiry methodology (Vavrus & Bartlett, 2013). The challenge is that when these new teachers are hired as secondary teachers, they are required to implement the learner-centered curriculum. Scholars in the area of learner-centered curriculum suggest that in order to promote science inquiry learning, teachers have to have expertise in meeting students' learning needs (Baviskar et al., 2009; Philips, 2000; Schiro, 2008; Tobin, 2000). In other words, teachers need to have enough knowledge of the learner-centered curriculum before they are asked to implement it in classrooms. Without training for teaching in the inquiry process, the introduction of the learner-centered curriculum in Tanzanian governmental secondary schools is hindered.

In addition to teacher professionalization, teacher professionalism is also important for teachers' effectiveness. Teacher professionalism is defined as teachers' acquisition of a particular expertise, authority, and autonomy by which they can determine their work conditions and their effectiveness as teachers

(Ornstein & Levine, 1997). Ornstein and Levine (2007) explain that despite the fact that nations around the world need teachers to educate their children, teacher professionalism is still a problematic issue in the education sector. This is because many countries do not measure teaching preparedness with the same criteria used in other professions, such as law or medicine. These criteria include not only knowledge but also professional autonomy and prestige (Ornstein & Levine, 1997). In the case of Tanzania, teacher professionalism has even more problems than when compared to other nations around the world. Participants in this study described that teachers in Tanzanian governmental schools do not have workshops or seminars to attend to update their teaching knowledge. Although the Ministry of Education and Vocational Training often introduces new curricula for teachers to implement, it does not provide funding for in-service training. One participant, a science teacher, said:

> You know science is not stationary; it changes often. For example, there are things that were taught from 2000 to 2008, but now they have changed. Even the science curriculum was changed from a teacher-centered curriculum to a learner-centered curriculum in 2005. Unfortunately, teachers have been asked to implement the new curriculum without having any in-service or seminars about how the new curriculum should be implemented. As a result, teachers keep using the old teaching methods. I think that is a problem.

This participant's description about the lack of seminars or workshops for in-service teachers clearly show there is a problem of teacher professionalism in the

Tanzanian governmental schools, especially when it comes to classroom practices. The problem of up-to-date knowledge for teachers was also noticed in this study during classroom observation activities. The researcher noticed there was a mismatch between the new science syllabi materials and the actual materials presented in classrooms. As was discussed previously, the new science syllabi materials demand that teachers implement the learner-centered curriculum, but for various reasons, teachers at the school where this research was conducted were still implementing the teacher-centered curriculum. The following paragraph of field notes describes what was observed in one of the biology classroom lectures.

> On May 10th in the afternoon, students were still on lunch break when the bell rang for the after-lunch class periods. The classroom was almost empty when the teacher started a short lecture about plant germination and growth characteristics. After 10 minutes, the classroom was full. This class was for senior students who are not majoring in science. After a few minutes of lecture, the teacher started copying notes directly from the textbook to the blackboard, and students copied the notes into their notebooks. The teacher listed some environmental conditions necessary for the seed to germinate. That list included water, temperature, and light. The student who had the textbook and was not copying asked a question in Swahili:
>
> Student1: Mwalimu, ni namna gani bengu zinaweza kupata mwanga chini ya udogo?" [which means, "Teacher, how can seeds get light when they are buried underground?"]

Teacher: There must be some light there.

Student1: Kama mbengu itakuwa imefukiwa chini kiasi cha urefu wa nchi tano, je, mwanga utapenya namna gani? [which means, "How can the light reach the seeds that are buried five inches deep?]

Teacher: There must be light there; it could be not much light, but there must be a little bit of light so that the seed can germinate.

After that teacher's answer, the student did not ask further questions. It is not known if the student was satisfied with the teacher's answer. Moreover, no other student asked any question; everyone was busy copying notes until the class period was over. In general, there was not much interaction between the teacher and the students. According to the new biology syllabus teaching and learning strategies, students were supposed to conduct an experiment to investigate the conditions necessary for germination. This experiment was not conducted.

There are several reasons that could be contributing to this type of pedagogical practice. One reason could be that teachers do not have enough time to prepare lessons prior to a class period. As described earlier, teachers' low salaries do not meet their living expenses. Therefore, they have to look for other alternatives to compensate their income (Semali & Mehta, 2012; Vavrus & Bartlett, 2013). Consequently, they do not have enough time to invest in their teaching career. The second reason could be that teachers prefer to use the teacher-centered teaching methodology. This methodology gives teachers the power over the students because teachers believe they have all the answers for their students. Freire (1970) describes this type of pedagogical approach as a "banking" form of education,

because teachers deposit knowledge and the students receive that knowledge without participation. In other words, a banking form of education does not develop students' participatory skills; students are viewed as individuals who are like empty vessels.

The third reason could be that of teacher professionalism. As described by the participants, teachers in the Tanzanian governmental school setting do not receive in-service trainings, such as seminars or workshops. They lack the knowledge for implementing new programs like the learner-centered curriculum that is mandated by the Ministry of Education. As noted earlier, not all Tanzanian teachers are trained in the inquiry methodology; therefore, most of the teachers are incapable of implementing the learner-centered curriculum (Vavrus & Bartlett, 2013). In general, it shows that the teaching and learning practices in the Tanzanian governmental secondary schools do not favor the science inquiry practice. As described by Mabula (2012) and Semali and Mehta (2012), the learner-centered science curriculum in Tanzanian secondary schools is actually present in curriculum guides, such as syllabi books, but it is hardly practiced in classrooms. This research also found that new science materials presented in the science syllabus and books have not yet been practiced in classrooms. In order to promote a learner-centered curriculum, the Tanzanian Ministry of Education needs to make sure that schools have enough funds and learning resources and that the class sizes are reduced. Also, both teacher professionalization and professionalism need to be improved.

Conclusion

This chapter highlighted the pedagogical issues that are limiting the implementation of science inquiry in the Tanzanian governmental secondary schools. The issues discussed in this chapter include teachers' limited knowledge about learner-centered curriculum, inadequate school facilities, lack of learning resources, the national examination policy, overcrowded classrooms, science teachers' low salaries, science teacher professionalization, and science teacher professionalism. By contextualizing the data analysis within a broader review of the literature, the researcher found that there are several similar educational issues that has been found in the United States, Sub-Saharan Africa, Latin America, and Europe (Lewin & Stuart, 2003a ; Semali & Mehta, 2012; Vavrus, & Bartlett, 2013). It has been found that science teachers in these nations feel the pressure of teaching large numbers of students, the pressure of preparing students for high-stakes examinations, pressure from having insufficient time to prepare lesson materials, and financial pressure due to inadequate salary, particularly when compared to other traditional professions, such as medicine or law (Lewin & Stuart, 2003a; Ornstein & Levine, 1997; Vavrus & Bartlett, 2013).

These educational challenges are particularly acute in Tanzanian government secondary schools. The Tanzanian governmental secondary schools' problems are not only about science teachers. The schools themselves suffer from limited funding and limited teaching and learning resources. They lack standard school facilities as compered to other nations (Semali & Mehta, 2012; Vavrus & Bartlett, 2013). The implementation of science inquiry teaching and learning pedagogy is more limited

in the Tanzanian governmental secondary schools than in other nations. The issues discussed in this chapter also reveal some challenges for Tanzanian politicians, educational policymakers, international donor agencies, and UNESCO as they enforce the learner-centered curriculum as a global education policy (Vavrus, & Bartlett, 2013). Enforcing the policy without putting into consideration both the availability of human resources and the availability of physical recourses in the target nations is challenging. The next chapter provides the conclusion, implications, limitations, and suggestions for future studies based on the research.

CHAPTER 7

Implications and Recommendations

As noted in Chapter 1, the aim of this study was to understand the relationship between the educational past and present in Tanzania with regard to secondary science education in governmental school settings. The study focused on examining issues and problems that are currently preventing the promotion of science inquiry in Tanzanian governmental schools. This study was accomplished by exploring how Tanzanian science educators responsible for secondary science education perceive post-colonial science education. A group of science educators who participated in this project include three secondary science teachers, two secondary science curriculum developers, two science educators responsible for secondary science assessment, and two science educators working in the Ministry of Education and Vocational Training office.

The research findings show that Tanzanian secondary science education has several historical issues and problems. These issues and problems include a Eurocentric science curriculum, poor learning and teaching pedagogy, the use of English as a language of instruction in secondary school settings, a lack of qualified science teachers, substandard school facilities, limited school resources, overcrowded classrooms, lack of motivation and support for science teachers, a lack of employment in the science field, the legacy of the colonial economic system, political control over the educational system, the impact of international agencies on the education sector, poor school management, and corruption.

By analyzing the data through Said's (1978) concept of Orientalism and post-

colonial theory more gerenrally, it is shown that most of the issues and problems in the Tanzanian educational system are historically connected to the impact of the colonial rule in the 19th century. That means that the colonial legacy in Tanzanian society has shaped the ideas and understanding of Tanzania's current economic and political practices. Consequently, that level of understanding and practice has influenced the educational system in terms of school training policies, the science curriculum, and the classroom pedagogy. In order to enact change and create a new understanding and practice in the secondary science education setting, this study has several implications that can be applied by the Tanzanian government and the Ministry of Education and Vocational Training. These implications include the following:

- revisiting the language of instruction policy for secondary education,
- improving the science curriculum so that it will honor both European science and Tanzanian traditional science theories,
- creating jobs in science fields,
- enabling collaboration between politicians and educational stakeholders,
- improving teachers' working conditions and professionalization,
- improving the school facilities,
- providing schools with more resources,
- revisiting the national examination policy,
- improving school management,

- eliminating corruption in the education sector and in other sectors as well,
- reducing the number of students per classroom, and
- supporting science teachers.

Revisiting the Language of Instruction Policy in Secondary Schools

The impact of instructing secondary students in English was discussed in Chapter 4. Data from classroom observation, interviews, and existing documentation shows that delivering instruction in English is a problem for both teachers and students. Consequently, the teaching and learning of science inquiry in the governmental secondary schools has been limited, because English is not well understood by students and teachers (Brock-Utne, 2007; Vavrus & Bartlett, 2013). Currently, empirical research data shows that science classrooms are lively when students are instructed in Kiswahili. Findings from Brock-Utne (2007) show that students participate more, ask more questions, and share their previous knowledge related to the subjects when they are instructed in Kiswahili. However, that classroom atmosphere changes when students are instructed in English. Students' participation is limited when students are instructed in English. For example, students tend to be quiet and do not ask questions (Brock-Utne, 2007).

On the other hand, the issue with instructing secondary students in English in Tanzania is political, and it is an economic issue that has nothing to do with providing quality secondary education. This means that there is political and economic pressure that has created a belief that Tanzanian graduates will have limited access to job opportunities and other global benefits if they are instructed in

Kiswahili. Currently, the majority of parents and the Tanzanian society in general believe that learning English or knowing English is an answer to their socio-economic problems. There are also scholars, such as Ogita (2000) and Maghimbi 1996; 2000), who argue that English is very important in Tanzanian society and instructing secondary students in English is vital. This is because knowing English serves as a powerful mechanism to acquiring a global knowledge of science and technology and access to socio-economic power, as opposed to Kiswahili (Maghimbi, 1996, 2000; Ogita, 2000).

Although Tanzanian politicians, parents, Ogita's (2000), and Maghimbi's (1996, 2000) arguments about the importance of instructing students in English are especially relevant in this period of globalization, these kinds of beliefs and attitudes have problems and limits. This is because any society cannot excel economically simply by knowing English. In order to excel economically, the Tanzanian society has to consider other key factors, such as providing quality education, creativity, hard work, good management, and freedom from corruption. Moreover, Tanzanian society needs to be well informed about the meaning of socio-economic development as well as quality education. While recognizing the importance of English as a global language—and that it is a vital language for Tanzanian society—I also argue that Tanzanians should not regard Kiswahili as an inferior language, but value it because Kiswahili presents their cultural value, tradition, and surroundings. That means Tanzanian society needs to develop an attitude that honors both their culture and European culture. Using Kiswahili to instruct students will help students understand the materials they learn in the classroom, as opposed to the current

practice. For example, in this study I observed in classroom that students were unable to identify millet, wheat, and kidney beans when they were described in English even though they are the food staples in the Tanzanian diet. However, these terms are well known in Kiswahili. In order to improve science education in secondary schools, the Ministry of Education and Vocational Training, together with the educational policymakers, need to create a balanced educational policy that would be academically beneficial to students, and at the same time, the policy has to help students master the English language.

I suggest that the educational policy help secondary students gain better understanding of science concepts. For instance, science subjects can be taught in Kiswahili because students will be able to make connections between what they are learning in classroom and the world that surrounds them. At the same time, in order to make sure that these students communicate well with other parts of the world, I suggest that English be seriously taught at all level of education. This means that Tanzanian governmental schools should teach English as subject from Kindergarten to college, as opposed to the current practice, which emphasizes learning English in post-primary education. Teaching English as subject at all levels of education will help students master the language, and it will help them to access socio-economic benefits outside Tanzania.

Improving the Science Curriculum and Job Creation in the Science Field

Participants in this study explained that the current secondary science curriculum is Eurocentric and contains some content materials that are not relevant to students' everyday cultural practice. Other studies also describe that the

Tanzanian science curriculum for secondary schools is still based on European culture and does not reflect or represent students' culture (Mosha, 2000; O-saki, 2005, 2007; Semali & Mehta, 2012). The issue with the Eurocentric science curriculum is historically connected to the colonial educational system. As noted in Chapter 2, during colonialism the materials used in classrooms perpetuated Eurocentric culture, and nothing related to African culture (Mosha, 2000; Ngugi wa Thiong'o, 1994). Additionally, during the colonial rule, Tanzanian science and technology was viewed as savage and uncivilized (Raid, 2005). Despite the fact that colonialism undermined Tanzanian and African science and technology, that traditional science knowledge did not die completely. Even today, African traditional scientific methods are still in place and in use, especially in agriculture, medicine, and liquor production. For example, in Tanzania and the other Eastern African nations, fishermen are using a fishing technique that preserves and conserves fish for future breeding. Further, small-scale farmers are also using the traditional post-harvest pest control system (Raid, 2005). These types of scientific knowledge and techniques can be integrated into the science curriculum.

In short, Tanzania as well as the other post-colonial African nations cannot disregard the European scientific knowledge in the school curriculum and its contribution to formal education, but these nations should not forget that they, too, have something to offer from their culture and knowledge. For this reason, there is a need to integrate Tanzanian scientific knowledge with European scientific knowledge. For instance, Tanzanian students are surrounded by rich natural resources that can be integrated into both the natural science curriculum and the

physical science curriculum. These resources include microorganisms, plants, soils, domestic animals, wild animals, marine animals, birds, and insects. In addition, Tanzania is rich in natural gas, minerals, water bodies, and other attractive landscapes. I suggest that the Tanzania's secondary science curriculum developers revisit the current curriculum and align it to the needs of Tanzanian students, based on local resources. Providing students with the opportunity to learn deeply and to conduct scientific investigation on surrounding natural resources will create a learning environment that promotes curiosity and creativity. The acquisition of curiosity and creativity then in turn results in the desire to observe, question, experiment, and discover new scientific knowledge that will be beneficial not only to Tanzanians, but also the rest of the world. For example, a study shows that scientists in South Africa are testing different indigenous plants that seem to be beneficial for treating illnesses like malaria, diabetes, tuberculous, and immune modulators (Horn, 2005). I suggest that Tanzanian society should learn from South Africa's practice in studying the available natural resources. The science school curriculum should include not only medicine-related scientific knowledge, but also other areas, such as natural gas, minerals, food, water, forests, and landscapes.

Besides the science curriculum, participants in this study discussed the lack of employment for Tanzanian students who are graduating in the science field. As a result, these graduate have to look for either other employment alternatives or jobs outside of Tanzania. Studies show that the lack of employment in the science field in Tanzania and in other Sub-Sahara African nations is due to the fact that these nations lack major industries that support strong science innovation (O-saki, 2005,

2007). Consequently, the lack of major industry has impacted students who have opted to study science at secondary and tertiary levels of education (O-saki, 2005, 2007). This problem is also historically connected to the colonial economic system, which was founded to benefit colonizers and not the native population. This type of colonial economic legacy has continued into the post-colonial economic system. It seems that since independence in 1961, the Tanzanian government has not yet invested in its people. Two of the participants in this study explained that Tanzania as a nation has many science experts and engineers, trained both abroad and within the country, but they are neither valued nor supported by the government. Instead of investing in them for the benefit of national development, the government imports engineers from abroad, who in turn employ the local engineers as cheap laborers (Uchida, 2009). This practice of devaluing local scientists and engineers over foreign investors and scientists presents additional evidence for the Orientalism discourse (Said, 1978). That means Tanzanian engineers and scientists might be classified as less professional or incapable of doing a quality job as opposed to foreign engineers or scientists. This type of mentality seems to deny the local people the power and opportunity to participate in their nation's socio-economic development. In order to support local scientists and engineers, the government needs to create a policy that honors both local and global investors. In addition, the government needs to create an organization that will provide some support and funding for local scientists and engineers so that they can provide good services to the society. Supporting local scientists and engineers will also create local jobs and could attract more students to study science in secondary schools.

Collaboration between Politicians and Educational Stakeholders

In Chapter 5, there is a discussion of a lack of collaboration between politicians, educators, and other school stakeholders. In this study, two participants explained that Tanzanian politicians often sign educational agreements with international organizations without involving educators and other school stakeholders. Consequently, the implementation of those agreements produces negative results. For example, the expansion of secondary education in the 2000s affected the secondary school sectors in such a way that students were attending schools where there are no teachers and learning resources (Mushi, 2009). In addition, the participants explained that Tanzanian politicians, especially those appointed to head the Ministry of Education and Vocational Training Office, tend to give orders for curriculum changes without collaborating with parents, teachers, and other educators. As a result, their orders have never produced positive results. The top-down administration by Tanzanian politicians clearly shows that the colonial political legacy still exists in the Tanzanian political system, and it affects the educational system. In order to create a collaborative environment in the educational sector, I suggest that Tanzanian politicians need to honor the African culture and tradition, which emphasizes collaboration and togetherness (Mosha, 2000). Chapter 2 also describes that before colonialism, the Tanzanian educational system involved all members of the community and was conducted in a collaborative way (Mosha, 2000; Ngugi wa Thiong'o, 1994). Integrating African cultural values into the post-colonial political system would create a shared power atmosphere in which teachers, parents, students, and other school stakeholders

could contribute their ideas for the improvement of the society.

I also suggest that Tanzanian politicians and those in charge of the educational policy learn from other countries how to involve parents and other members of the community in children's educational process. Studies show that parental and family involvement in their children's education, especially at the elementary and secondary levels, has improved children's academic achievement (Hornby & Witte, 2010; Jeynes, 2005). For example, in New Zealand parents and families have been given priority for their children's education, and it has shown improvements in students' attitudes, behavior, and school attendance (Hornby, & Witte, 2010). The authors also add that because of the effectiveness of parents' involvement in their children's education, teacher-parent relationships have been stronger and the school climate has improved (Hornby & Witte, 2010).

The same approach has been used in the Turkish educational system. It shows that involving parents in the Turkish educational system has produced positive outcomes, especially improving students' attendance, academic achievement, motivation, school attachment, responsibility, confidence, motivation, and discipline (Hiatt-Michael, 2008). In the Turkish educational system, parents are considered to be shareholders who actively help with creating a democratic school environment, support educational and instructional activities, and help and guide students, especially in social activities (Hiatt-Michael, 2008). Taymaz (1995) also emphasizes the importance of involving parents in their children's education process. Tayman argues that the role of parents as teachers to their children does not end when their children attend schools. This is because formal education is not

limited within school boundaries. Therefore, parents and families have to play a major role in the school curriculum (Taymaz, 1995). For the purpose of improving science education in Tanzanian governmental schools, I suggest that Tanzanian educational leaders involve other members of the community to participate in their children's education process. This could result in helping the Ministry of Education and Vocational Training to address the lack of school resources and school facilities, which currently is a major problem in most of the governmental secondary school settings.

Besides involving parents and other community members in the educational system, Tanzanian politicians, especially those appointed to oversee the education sector, have to involve teachers in the curriculum development process. As noted in Chapter 6, science teachers who participated in this study explained the problem caused by the reform of the secondary science curriculum without their involvement. The major issue is that oftentimes the Tanzanian Ministry of Education and Vocational Training makes changes to the science curriculum, but those changes are rarely implemented because science teachers are not well informed about them. For example, in 2005, the secondary science curriculum was changed from a teacher-centered curriculum to a student-centered curriculum, and the science syllabi were distributed in secondary schools for teachers to implement. At the school where I conducted this study, I observed and learned that science teachers are still implementing a teacher-centered curriculum. The teachers explained that they are still practicing this teacher-centered curriculum because they do not have enough knowledge about how to implement the student-centered curriculum. In

addition, these teachers do not know the reason why they should shift their teaching methods from that of teacher-centered curriculum to that of student-centered curriculum.

The issue of teachers' role in curriculum development may not be only in Tanzania, but studies show that nations that eliminate teachers' participation in the curriculum process have classroom pedagogical problems. For example, Leat and Higgins (2002) describe that teachers in England and Wales have been handled a package of prepared syllabi materials from their education authority. Although the syllabi instruct teachers on how to implement the syllabi in the classroom, the results have not been impressive (Leat & Higgins, 2002). Research findings also show that in South Africa teachers are excluded from participation in curriculum development. Teachers only implement the curriculum in their classrooms, and the curriculum is handed to them from the authority (Carl, 2005). This situation has reduced teachers' control over school curriculum. Tanzania's educational system might be carrying on the colonial legacy of the British educational system by excluding teachers from curriculum preparation, but that practice has its own consequences. In order to turn around the current practice, Tanzania should learn from other nations to honor the role of teachers in the school system. Studies show that Japan is one of the nations in which teachers are highly respected, and teachers participate fully in the school curriculum development process. Additionally, teachers' decisions and input are highly regarded in the school system (Kobow & Fossum, 2003). If the Tanzanian Ministry of Education and Vocational Training really wants to promote the student-centered science curriculum in the classroom, I

suggest the Ministry take certain steps. First, the Ministry needs to discuss curriculum changes in detail with the Tanzanian Teacher Union so that the Teacher Union can inform teachers about those changes. Second, the Ministry must give science teachers the opportunity to contribute their ideas during the curriculum reform process. Third, the Ministry must provide funds that will be used for seminars and workshops that will train teachers on the student-centered science curriculum before asking them to practice it in the classroom. Fourth, the Ministry has to make sure that all schools have enough teaching and learning resources to support the student-centered curriculum.

The Improvement of Teacher Professionalization and Working Conditions

In this study, participants discussed the issue of teachers' compensation and professionalization in governmental secondary school settings. Participants indicated that low salaries and lack of other motivations and supports have discouraged science teachers from investing their time in schools. It is hard for teachers to invest when they do not have a living wage and must seek additional employment to survive. Participants also described how a career in teaching has been classified as a second-hand career, as opposed to other traditional careers, such as medicine, engineering, and law. Furthermore, despite the fact that most of the governmental schools have many problems, such as a lack of teaching and learning resources, large classroom populations, sub-standard classrooms, lack of laboratories and libraries, and lack of seminars or in-service experiences for teachers, when students do not do well in the national examinations, teachers are blamed for not doing their job. Besides classifying a teaching career as a second-

hand career, Tanzanian society has also developed the mentality of viewing teachers as the cause of students' academic poor performances, especially in the science area. This type of stereotype and generalization has discouraged qualified candidates from joining the field of education.

By analyzing the data through the post-colonial lens, I see that Tanzanian society is having a problem with stereotyping teachers without considering the other issues and problems that are surrounding schools. Said's (1978) writing on Orientalism describes that stereotype and generalization are major elements of the Orientalism discourse and can cause social problems. This is because through Orientalism, people tend to judge a group of individuals who are thought to be "problems" without putting into consideration other circumstance that can cause issues. In the case of Tanzania, secondary teachers have been stereotyped as the single cause of students' poor academic performance, despite the fact that most of the governmental secondary schools have many problems, as described in the previous paragraph. Those types of problems make it impossible to produce the quality of education expected by the society.

In order to improve science education in Tanzanian governmental schools, I suggest that all of the current issues and problems facing the schools must be resolved. First, the school environment conditions for both students and teachers must be improved. That means the Ministry of Education and Vocational Training must make sure that schools are getting enough teaching and learning resources, such as books and science laboratory tools. Second, the issue of teacher-student ratio must be solved. Teachers, especially in science classrooms, should not have

more than 45 students. Third, science teachers must be paid reasonable salaries. In this study, participants discussed that science teachers are overworked and are required to spend extra time to provide lab work for students but are paid salaries that are equal to the salaries of other teachers who do not teach science subjects. This teachers' equal pay policy has discouraged science teachers from spending extra time with students or giving students lab work. In order to motivate science teachers, the Ministry of Education and Vocational Training must value science teachers' work and time and pay them accordingly.

While improving and resolving school problems and science teachers' compensation, teacher education programs and working conditions also need to be improved and aligned to other traditional professions, such as medicine, and law. In addition, the Ministry of Education and Vocational Training needs to empower teachers and all educators in order to not just improve instruction, but also to generate educational practices and policies that honor broader ways of thinking about the purpose and practice of education. Studies show that competitive teachers' compensation and standard living conditions for teachers attract qualified teacher candidates and reduce teachers' turnover (Corcoran et al., 1988). Additionally, low-standard physical living conditions are described to have a direct negative effect on teachers' morale, sense of personal safety, and effectiveness in classrooms (Corcoran et al., 1988). Corcoran et al. (1988) also add that that where there are problems with working conditions, teachers always reduce their level of effort and are less effective in the classrooms because of reduced job satisfaction. If the Tanzanian Ministry of Education and Vocational Training really wants to

improve secondary science education, then it is important to improve both teachers' living status and teachers' working conditions.

Improving the School Funding System

In this study, participants explained that most of the governmental secondary schools, especially in rural areas, lack necessary school resources, like desks, laboratories, libraries, and teacher housing. At the school site where this study was conducted, the researcher observed that the school has science laboratory rooms, but the rooms are not well equipped. For example, the laboratories have laboratory sinks, water taps, and gas outlets, but there is no gas or running water in them. In addition, despite the fact that the school is within the city, the school has no library. This learning environment does not support scientific inquiry practices. Studies show that good school facilities and learning environment conditions are important elements that contribute to students' academic achievement, provided that other elements such as qualified teachers and learning resources are available (McGuffey, 1982). However, sub-standard school facilities and poor learning environment conditions have been found to have a direct negative impact on students' academic achievement and teachers' effectiveness and job satisfaction (Corcoran et al., 1988). In order to promote science inquiry learning in Tanzanian governmental secondary schools, the Ministry of Education and Vocational Training needs to pay close attention to improving the school facilities. That means the Ministry has to allocate enough funds that will support the schools and be able to construct standard science laboratories and libraries.

In his study, O-saki (2007) explains that since the late 1960s, the Tanzanian governmental secondary schools have been financially struggling. As a result, promoting programs such as inquiry teaching and learning have been difficult. Consequently, educational projects, such as research, workshops, and seminars, depend heavily on money from international donor agencies (O-saki). It may be true that the money from international donor agencies somehow supports some of the Tanzanian government's educational projects, but the government should not depend heavily in that money to support the education sector. In order to provide enough funding that will help to improve science education in governmental schools, I suggest that the government give education first priority on the annual budget. In addition, the government must find strategies for generating money from within and reduce its dependence on international donor agencies. There are several post-colonial nations that have been relieved from being donor-dependent nations, and they use locally generated money to fund their schools. For example, since independence in 1990s, the government of Namibia has decreased its dependence on external funds from 13% of its total revenue in to less than 1% (Marope, 2005). This country generates its revenue using available sources, such as income tax, property tax, and domestic resources, and that revenue provides enough funds to support the education sector and other social service sectors (Marope, 2005). The Tanzanian government can learn from the Namibian government on how to generate revenue from available resources. In addition, the Tanzanian Ministry of Education and Vocational Training can establish annual

school fundraising programs in which Tanzanians through their own will donate money to support schools.

Recommendations for Future Research

This research was limited to nine participants who represented the views of individuals. These individuals include three science teachers, two administrators from the Tanzanian Institute of Education, two administrators from the National Examination Council of Tanzania, and two administrators from the Ministry of Education and Vocational Training. All of these individuals are currently working in Tanzanian science education settings. Their shared experiences contribute to a new understanding of the current issues and problems in Tanzanian governmental secondary school settings. These issues include a low-quality science curriculum, the use of English as language of instruction in secondary schools, a lack of funding to support school programs, a lack of qualified science teachers, inadequate school facilities, a lack of support for science teachers, and a lack of support for local scientists. From these findings, much more qualitative research can be initiated based on this research data. I recommend that a research study like this one be conducted that includes students, parents, and other members of society, so that they can give their views about Tanzanian secondary science education. I also recommend for another study that will compare science teachers' job satisfaction between teachers working in private schools and teachers working in governmental schools. Another research study could investigate how Tanzanian private secondary schools are supporting teachers in comparision with governmental schools. Furthermore, I suggest that a comparative qualitative research study of the former

British colonized nations be conducted that will compare post-colonial science education development and achievement. For example, the research could compare the Tanzanian secondary curriculum to that of India. Studies show that since India gained its independence from Britain, it has managed to integrate its culture and tradition into the colonial education, which has produced something new, called "Modern India" (Monahan, 2012). This study will help the Tanzanian curriculum developers to develop a competative curriculum as opposed to the current one.

In addition, I suggest that more qualitative studies investigating the issue of using English as language of instruction in secondary schools be conducted. The available pro-English studies argue that students must be instructed in English because English will provide employment and other socio-economic benefits (Maghimbi, 1996, 2000; Ogita, 2000). On the other hand, there are studies, including this one, that show that secondary students do not understand science subjects very well when they are instructed in English (Brock-Utne, 2007; Neke, 2005; Vavrus & Bartlett, 2013). However, these studies suggest that in order to help secondary students understand science concepts, they have to be instructed in Kiswahili, and they should learn English as a subject. In order to solve the conflict of which language should be used to instruct Tanzanian secondary students in government school settings, the Tanzanian Ministry of Education and Vocational Training needs to conduct long-term research on the issue. I suggest that a case study be conducted in which five to 10 governmental secondary schools are selected as experimental schools and another five to 10 governmental schools can be used as control schools. Students in the experimental schools will learn science subjects in

Kiswahili, and English language classes will be taught to them by professional English teachers. The control schools will maintain the current practice of teaching all subjects in English. At the end of the study, the researchers will examine students' understanding and mastering of both science subjects and English language subjects. The study can also include classroom observations of students' participation, and the researcher can interview students to determine whether they understand more when they are taught in Kiswahili or if there are no differences. The results of this case study will provide insight into Tanzanian education system and can be used to decide whether to reform current educational policies or to maintain them.

Appendix A: Interview Guide for Teachers

Grad Tour Questions

1. Tell me about your education background.
2. How long have you been working in this department?
3. Tell me about your experience with secondary science education.
    - How do students like science subjects?
    - Data from the national examination results show more students in government schools are choosing humanities subjects more than science subjects as their study focus. Why do you think this is so?
4. Has your perception about secondary science education changed over the past five years? If yes, how? If not, why?
5. What are major problems facing secondary science education?
6. Are there any problems regarding teacher-student ratio? How large are classes?
7. How does the government fund secondary science education?
8. How do you think our current school system reflects, or is influenced by, our colonial history?
9. In what ways has been secondary science education influenced by our colonial past? How is the colonial legacy influencing our science education today?
10. If you could make changes to the current secondary science education system, what would you suggest?

11. If you could make any changes to the curriculum, national examination, and/or classroom practice, what would you suggest?
12. Is there anything else you would like to say about secondary science education?
13. In 2001, the government published a development plan that aims to transform Tanzania society from poverty to a middle-class income society by 2025. What is the involvement of your school in this initiative? Does your school have any specific strategies that have been implemented?
    - What role does science education have in efforts to reduce poverty?
    - If so, what is it about science education that is important in this process?

Specific Questions

1. Tell me about your experience of teaching [your particular science subject, i.e., Biology, Chemistry, or Physics]?
2. What type of challenges do you face in classroom?
3. How do you motivate students to learn [biology, chemistry, or physics]?
    - Are students motivated to learn science subjects? Why/Why not?
    - How does our education system encourage students to learn science subjects?
4. Does your school offer students an opportunity to work on science projects beyond that of classroom laboratory work?

5. How are science projects included in the syllabus? Does the curriculum provide you an opportunity to conduct science projects that are not provided in a syllabus?
6. How do you balance covering the materials provided in the syllabus and preparing students for the national examination?
7. How do you encourage students to not only focus on preparing for the national examination, but also learn science as something meaningful to their future life?

Appendix B: Interview Guide for Individuals from the Ministry of Education and Vocational Training (MoEVT)

Grad Tour Questions

1. Tell me about your education background.
2. How long have you been working in this department?
3. Tell me about your experience with secondary science education.
    - How do students like science subjects?
    - Data from the national examination results show more students in government schools are choosing humanity subjects more than science subjects as their study focus. Why do you think this is so?
4. Has your perception about secondary science education changed over the past five years? If yes, how? If not, why?
5. What are major problems facing secondary science education?
    - Are there any problems regarding teacher-student ratio? How large are classes?
    - How does the government fund secondary science education?
6. How do you think our current school system reflects, or is influenced by, our colonial history?
    - In what ways has been secondary science education influenced by our colonial past? How is the colonial legacy influencing our science education today?

7. If you could make changes to the current secondary science education system, what would you suggest?
8. If you could make any changes to the curriculum, national examination, and/or classroom practice, what would you suggest?
9. Is there anything else you would like to say about secondary science education?
10. In 2001, the government proposed a development vision that aims to transform Tanzania society from poverty to a middle class income society by 2025. What is the involvement of your office in this initiative? Does your office have any specific strategies that have been implemented?
    - What role does science education have in efforts to reduce poverty?
    - If so, what is it about science education that is important in this process?

Specific Questions

1. From your experience, what issues or factors are causing secondary students in government schools to perform poorly, or perform well, in science subjects?
2. Where they perform poorly, what should be done to improve their performance?
    - Does your office, or anyone else who you know of, have any ideas or plans for resolving these problems?
3. Does your office provide opportunities for students to participate in science projects beyond that provided in the classroom?

- What type of projects?

4. What direction do you think we (Tanzania) should take with regard to science education? Why? How? What would make this possible?

Appendix C: Interview Guide for Individuals from the Tanzanian Institute of Education (TIE)

Grad Tour Questions

1. Tell me about your education background.
2. How long have you been working in this department?
3. Tell me about your experience with secondary science education.
    - How do students like science subjects?
    - Data from the national examination results show more students in government schools are choosing humanity subjects more than science subjects as their study focus. Why do you think this is so?
4. Has your perception about secondary science education changed over the past five years? If yes, how? If not, why?
5. What are major problems facing secondary science education?
    - Are there any problems regarding teacher-student ratio? How large are classes?
    - How does the government fund secondary science education?
6. How do you think our current school system reflects, or is influenced by, our colonial history?
    - In what ways has been secondary science education influenced by our colonial past? How is the colonial legacy influencing our science education today?

7. If you could make changes to the current secondary science education system, what would you suggest?
8. If you could make any changes to the curriculum, national examination, and/or classroom practice, what would you suggest?
9. Is there anything else you would like to say about secondary science education?
10. In 2001, the government proposed a development plan that aims to transform Tanzanian society from poverty to a middle-class income society by 2025. What is the involvement of your office in this initiative? Does your office have any specific strategies that have been implemented?
    - What role does science education have in efforts to reduce poverty?
    - If so, what is it about science education that is important in this process?

Specific Questions

1. Tell me about your experience with secondary science curricula.
2. In 2005, the secondary biology syllabus was revised from that of content-based curriculum to a competence-based curriculum. Why?
    - How has this change been received by schools? Teachers? Students?
    - What have the successes and challenges been with this change?
3. Has your office determined any students' learning progress or achievement since the implementation of the new syllabus?
    - Has your office received any feedback or suggestions from secondary biology teachers?

- What strategies does your office use to evaluate the curriculum?

4. How is the current science curriculum is preparing future scientists?
    - How does the current science curriculum address the issues of Tanzanian infrastructure?
    - How does the current science curriculum address the issue of improving Tanzanians' living conditions?
    4. How does the current secondary science curriculum prepare students to meet everyday challenges? In rural village areas? In urban areas?
    5. How does the current science curriculum address the issues of climate change, renewable energy, and environmental conservation?
    6. How does the current science curriculum prepare students for further education (i.e., medical school, agriculture, engineering) and for self-employment?

Appendix D: Interview Guide for individuals from the National Examination Council of Tanzania (NECTA)

Grad Tour Questions

1. Tell me about your education background.
2. How long have you been working in this department?
3. Tell me about your experience with secondary science education.
    - How do students like science subjects?
    - Data from the national examination results show more students in government schools are choosing humanity subjects more than science subjects as their study focus. Why do you think this is so?
4. Has your perception about secondary science education changed over the past five years? If yes, how? If not, why?
5. What are major problems facing secondary science education?
    - Are there any problems regarding teacher-student ratio? How large are classes?
    - How does the government fund secondary science education?
6. How do you think our current school system reflects, or is influenced by, our colonial history?
    - In what ways has been secondary science education influenced by our colonial past? How is the colonial legacy influencing our science education now?

7. If you could make changes to the current secondary science education system, what would you suggest?
8. If you could make any changes to the curriculum, national examination, and/or classroom practice, what would you suggest?
9. Is there anything else you would like to say about secondary science education?
10. In 2001, the government proposed a development plan that aims to transform Tanzania society from poverty to a middle class income society by 2025. What is the involvement of your office in this initiative? Does your office have any specific strategies that have been implemented?
    - What role does science education have in efforts to reduce poverty?
    - If so, what is it about science education that is important in this process?

Specific Questions

1. Tell me about your experience with secondary science national examinations.
2. Tell me about the patterns you see in students' test score performance in science subjects in government schools.
    - How is your office working toward improving students' performance?
3. What other forms of evaluation are used to evaluate students' academic performance besides the national examination?
4. What is your assessment of students who have good academic records but do not perform well on the national examination?

- What does the national exam assess, in terms of science?
- How does the national exam evaluate students' talents, curiosity, or critical thinking skills? What other forms of evaluation or assessment of these kinds of skills and characteristics exist, beyond what is assessed in the written national examination?

5. What other strategies does your office use to evaluate students' academic performance?

Appendix E: Interview Guide Documents Translated Into Swahili

Kiambatisho E: Mwongozo wa Mahojiano na Walimu

Maswali ya Jumla

1. Nielezee usuli kuhusu elimu yako?
2. Ni kwa muda gani tangu umekuwa mwalimu?
3. Nielezee uzoefu wako kuhusu elimu ya sayansi katika elimu ya secondary?
    - Je, ni kwa kiasi gani wanafunzi wanapenda masomo ya sayansi?
    - Kwenye orodha ya matokeo ya mitihani kutoka kwenye baraza la mitihani (NECTA) yanaonesha kwamba, wanafunzi wengi katika shule za serikali hawasomi masomo ya sayansi. Kwa nini nikuwa hivo?
4. Kutokana na mwelekeo wa masomo ya sayansi katika elimu ya secondary ilivo kwa sasa, je, katika miaka mitano iliyopita, musimamo wako kuhusu masomo ya sayansi hapa inchini umeshabadirika? Kama ndio, ni kwa namna gani? Kama hapana, ni kwa nini?
5. Je ni matatizo gani yanayoikabiri elimu ya sayansi katika shule za secondary?
    - Idadi ya wanafunzi katika madarasa inaridhisha? Je idadi ya wanafunzi katika darasa ni kubwa kiasi gani?
    - Ni kwa namna gani serikali inatoa muchango wake katika kuendeleza elimu ya sayansi?

6. Ni kwa namna gani unafikiri mufumo wa shule zetu bado una athari za ukoloni?
    - Ni kwa vigezo vipi unafikiri elimu ya secondary, hasa upande wa sayansi bado una athari za ukoloni? Ni kwa namna gani urithi wa elimu kikoloni bado una athari kwenye elimu ya sasa?
7. Kama ungeweza kufanya mabadiliko kwenye mfumo wa elimu ya secondary hasa kwenye masomo ya sayansi, ungeshauri je?
8. Kama ungeweza kufanya mabadiliko kwenye mtaala wa sayansi, utoaji wa mitahani ya kidato cha nne, na ufundishaji darasani, je ungebadisha nini?
9. Je, ungependa kuongezea chochote kuhusu elimu ya sayansi hapa inchini?
10. Kwenye mwaka wa 2001, serikali ilichapisha nyaraka kuhusu mpango wa maendeleo unaodhamilia kufuta au kupunguz umaasikini kwenye jamii ya Tanzania ifikapo mwaka 2025. Je shule za secondari zinachagia vipi katika ari hii? Je hii shule inamikakati yoyote juu ya utekelezaji wa ari hii?
    - Ni kwa namna gani elimu ya sayansi imechipanga katika maswala ya kupuguza umasikini inchini?
    - Kama mikakati ipo, ni kwa namna gani elimu ya sayansi ni muhimu katika kupunguza umaskini?

Maswali Mahususi

1. Nieleze kuhusu uzoefu wako wa kufundisha [mahususi somo la sayansi i.e., biologia, chemia, au fizikia]?
2. Ni chagamoto zipi unapata darasani?
3. Ni njia zipi unatumia kuhamasisha wanafunzi kuifuza [biologia, chemia, au fizikia]?
    - Je, wanafunzi wako wanahamasika kujifunza?
    - Ni kwa namna gani mfumo wetu wa elimu unawatia moyo wanafunzi kujifunza masomo ya sayansi?
4. Je, shule yako inatoa fursa kwa wanafunzi kufanya utafiti kisayansi inje ya kile wanachojufunza darasani?
5. Ni kwa namna gani utafiti wa kisayansi umewekwa katika muhtasari? Je mtaala wa sayansi unatoa fursa kwa wanafunzi kufanya utafiti wa kisayansi ambao haumo kwenye muhtasari?
6. Katia uzoefu wako wa kufundisha, je, ni njia zipi unatumia kumaliza muhtasari na hapo hapo ukaweza kuwaandaa wanafunzi kwa mtihani wa kidato cha nne bila kukaririsha walichojifunza?
7. Ni jinsi gani unawatayarisha wanfunzi sio tu kwa mitihani yao ya mwisho, bali umhim wa elimu ya sayansi katika maisha yao ya kila siku ?

Kiambatisho F: Mwongozo wa Mahojiano na Wizara ya Elimu (MoEVT)

Maswali ya Jumla

1. Nielezee usuli kuhusu elimu yako?
2. Ni kwa muda gani tangu umekuwa mfanyakazi katiaka idara hii?
3. Nielezee uzoefu wako kuhusu elimu ya sayansi katika elimu ya secondary?
   - Je, ni kwa kiasi gani wanafunzi wanapenda masomo ya sayansi?
   - Kwenye orodha ya matokeo ya mitihani kutoka kwenye baraza la mitihani (NECTA) yanaonesha kwamba, wanafunzi wengi katika shule za serikali hawasomi masomo ya sayansi. Kwa nini nikuwa hivo?
4. Kutokana na mwelekeo wa masomo ya sayansi katika elimu ya secondary ilivo kwa sasa, je, katika miaka mitano iliyopita, musimamo wako kuhusu masomo ya sayansi hapa inchini umeshabadirika? Kama ndio, ni kwa namna gani? Kama hapana, ni kwa nini?
5. Je ni matatizo gani yanayoikabiri elimu ya sayansi katika shule za secondary?
   - Idadi ya wanafunzi katika madarasa inaridhisha? Je idadi ya wanafunzi katika darasa ni kubwa kiasi gani?
   - Ni kwa namna gani serikali inatoa muchango wake katika kuendeleza elimu ya sayansi?
6. Ni kwa namna gani unafikiri mufumo wa shule zetu bado una athari za ukoloni?

- Ni kwa vigezo vipi unafikiri elimu ya secondary, hasa upande wa sayansi bado una athari za ukoloni? Ni kwa namna gani urithi wa elimu kikoloni bado una athari kwenye elimu ya sasa?

7. Kama ungeweza kufanya mabadiliko kwenye mfumo wa elimu ya secondary hasa kwenye masomo ya sayansi, ungeshauri je?
8. Kama ungeweza kufanya mabadiliko kwenye mtaala wa sayansi, utoaji wa mitahani ya kidato cha nne, na ufundishaji darasani, je ungebadisha nini?
9. Je, ungependa kuongezea chochote kuhusu elimu ya sayansi hapa inchini?
10. Kwenye mwaka wa 2001, serikali ilichapisha nyaraka kuhusu mpango wa maendeleo unaodhamilia kufuta au kupunguz umaasikini kwenye jamii ya Tanzania ifikapo mwaka 2025. Je shule za secondari zinachagia vipi katika ari hii? Je hii shule inamikakati yoyote juu ya utekelezaji wa ari hii?
    - Ni kwa namna gani elimu ya sayansi imechipanga katika maswala ya kupuguza umasikini inchini?
    - Kama mikakati ipo, ni kwa namna gani elimu ya sayansi ni muhimu katika kupunguza umaskini?

Maswali Mahususi

1. Katika uzoefu wako, ni matatizo gani yanasababisha wanafunzi wa kidato cha nne kwenye shule za serikali kufanya vibaya katika masomo ya sayansi?
2. Unafikiri nini kinaweza kufanyika ili kuinua kiwango cha ufaulu?
    - Katika kitengo cha kazi, mna mpango wowote au mawazo yoyote ya kushughulikia hili tatizo?

3. Katika idara yako mna toa fursayoyote kwa unafunzi kufanya utafiti wa elimu ya sayansi inje ya kile wanajifunza darasani?
    - Je ni fursa zipi mnazotoa?

4 Unafikiri ni mwelekeo upi Watanzania wanapaswa kufuata kuhusu elimu ya sayansi? Ni kwa nini iwe hivo? kwa namna gani? Ni nini kinakiwa kufanyika ili elimu ya sayansi iwe bora zaidi kuliko ilivo sasa?

Kiambatisho G: Mwongozo wa Mahojiano na Idara ya Mitaala (TIE)

Maswali ya Jumla

1. Nielezee usuli kuhusu elimu yako?
2. Ni kwa muda gani tangu umekuwa mfanyakazi wa idara hii?
3. Nielezee uzoefu wako kuhusu elimu ya sayansi katika elimu ya secondary?
    - Je, ni kwa kiasi gani wanafunzi wanapenda masomo ya sayansi?
    - Kwenye orodha ya matokeo ya mitihani kutoka kwenye baraza la mitihani (NECTA) yanaonesha kwamba, wanafunzi wengi katika shule za serikali hawasomi masomo ya sayansi. Kwa nini nikuwa hivo?
4. Kutokana na mwelekeo wa masomo ya sayansi katika elimu ya secondary ilivo kwa sasa, je, katika miaka mitano iliyopita, musimamo wako kuhusu masomo ya sayansi hapa inchini umeshabadirika? Kama ndio, ni kwa namna gani? Kama hapana, ni kwa nini?
5. Je ni matatizo gani yanayoikabiri elimu ya sayansi katika shule za secondari?
    - Idadi ya wanafunzi katika madarasa inaridhisha? Je idadi ya wanafunzi katika darasa ni kubwa kiasi gani?
    - Ni kwa namna gani serikali inatoa muchango wake katika kuendeleza elimu ya sayansi?
6. Ni kwa namna gani unafikiri mufumo wa shule zetu bado una athari za ukoloni?
    - Ni kwa vigezo vipi unafikiri elimu ya secondary, hasa upande wa sayansi bado una athari za ukoloni? Ni kwa namna gani urithi wa elimu kikoloni bado una athari kwenye elimu ya sasa?

7. Kama ungeweza kufanya mabadiliko kwenye mfumo wa elimu ya secondari hasa kwenye masomo ya sayansi, ungeshauri je?
8. Kama ungeweza kufanya mabadiliko kwenye mtaala wa sayansi, utoaji wa mitahani ya kidato cha nne, na ufundishaji darasani, je ungebadisha nini?
9. Je, ungependa kuongezea chochote kuhusu elimu ya sayansi hapa inchini?
10. Kwenye mwaka wa 2001, serikali ilichapisha nyaraka kuhusu mpango wa maendeleo unaodhamilia kufuta au kupunguz umaasikini kwenye jamii ya Tanzania ifikapo mwaka 2025. Je shule za secondari zinachagia vipi katika ari hii? Je hii shule inamikakati yoyote juu ya utekelezaji wa ari hii?
    - Ni kwa namna gani elimu ya sayansi imechipanga katika maswala ya kupuguza umasikini inchini?
    - Kama mikakati ipo, ni kwa namna gani elimu ya sayansi ni muhimu katika kupunguza umaskini?

Maswali Mahususi

1. Katika uzoefu wako, nieleze kuhusu mitaala ya elimu ya sayansi katika gazi ya secondari?
2. Katika mwaka wa 2005, ni kwa sababu zipi ulisababisha muhtasari wa somo la biologia ulibadirishwe kutoka mtaala wa maudhui kwenda mtaala wa ustadi?
    - Ni kwa jinsi gani shule, walimu na wanafunzi walipokea mabadiliko haya?
    - Je, ni mafanikio yapi au changamoto zipi mumeshapata kutokana na haya mabadiliko?

3. Katika idara yako, mumeshapata mafanikio yoyote yanayoonesha mafanikio mazuri ya wanafunzi tangu muhtasari mpya uanze kutumika?
    - Katika idara yako mumeshapokea malalamiko au mapendekezo yoyote kutoka kwa walimu wa biologia?
    - Katika idara yako, ni mikakati ipi mnayotumia kutathmini mtaala?
4. Ni kwa jinsi gani mtaala wa sayansi unaotumika kwa sasa unawaandaa wanafunzi kuwa wanasayansi maarufu wa taifa la kesho?
    - Ni kwa jinsi gani mtaala wa sayansi unaotumika kwa sasa unasaidia kutatua matatizo ya miundo mbinu ya nchi? (kama vile maji, umeme, barabara, kilimo, afya, n.k.)
    - Ni kwa jinsi gani mtaala wa sayansi unasadia kuboresha maisha ya Mtanzania?
5. Ni kwa jinsi gani mtaala wa sayansi unaotumika kwa sasa unamwandaa mwanafuzi wa secondari kuyamudu matatizo ya maisha anayumbana nayo vijijini au mijini?
6. Ni kwa jinsi gani mtaala unaotumika kwa sasa unaelimisha wanafunzi kuhusu mabadiliko ya hali ya hewa, utunzaji wa mazingira, na teknolojia mbadara?
7. Ni kwa jinsi gani mtaala wa sasa unamwadaa mwanafuzi kwa masomo ya badae [kama vile, idara ya afya, kilimo, uhandisi, na ujasilimali]?

Kiambatisho H: Mwongozo wa Mahojiano na Idara ya (NECTA)

Maswali ya Jumla

1. Nielezee usuli kuhusu elimu yako?
2. Ni kwa muda gani tangu umekuwa mfanyakazi wa idara hii?
3. Nielezee uzoefu wako kuhusu elimu ya sayansi katika elimu ya secondary?
    - Je, ni kwa kiasi gani wanafunzi wanapenda masomo ya sayansi?
    - Kwenye orodha ya matokeo ya mitihani kutoka kwenye baraza la mitihani (NECTA) yanaonesha kwamba, wanafunzi wengi katika shule za serikali hawasomi masomo ya sayansi. Kwa nini nikuwa hivo?
4. Kutokana na mwelekeo wa masomo ya sayansi katika elimu ya secondary ilivo kwa sasa, je, katika miaka mitano iliyopita, musimamo wako kuhusu masomo ya sayansi hapa inchini umeshabadirika? Kama ndio, ni kwa namna gani? Kama hapana, ni kwa nini?
5. Je ni matatizo gani yanayoikabiri elimu ya sayansi katika shule za secondary?
    - Idadi ya wanafunzi katika madarasa inaridhisha? Je idadi ya wanafunzi katika darasa ni kubwa kiasi gani?
    - Ni kwa namna gani serikali inatoa muchango wake katika kuendeleza elimu ya sayansi?
6. Ni kwa namna gani unafikiri mufumo wa shule zetu bado una athari za ukoloni?
    - Ni kwa vigezo vipi unafikiri elimu ya secondary, hasa upande wa sayansi bado una athari za ukoloni? Ni kwa namna gani urithi wa elimu kikoloni bado una athari kwenye elimu ya sasa?

7. Kama ungeweza kufanya mabadiliko kwenye mfumo wa elimu ya secondary hasa kwenye masomo ya sayansi, ungeshauri je?
8. Kama ungeweza kufanya mabadiliko kwenye mtaala wa sayansi, utoaji wa mitahani ya kidato cha nne, na ufundishaji darasani, je ungebadisha nini?
9. Je, ungependa kuongezea chochote kuhusu elimu ya sayansi hapa inchini?
10. Kwenye mwaka wa 2001, serikali ilichapisha nyaraka kuhusu mpango wa maendeleo unaodhamilia kufuta au kupunguz umaasikini kwenye jamii ya Tanzania ifikapo mwaka 2025. Je shule za secondari zinachagia vipi katika ari hii? Je hii shule inamikakati yoyote juu ya utekelezaji wa ari hii?
    - Ni kwa namna gani elimu ya sayansi imechipanga katika maswala ya kupuguza umasikini inchini?
    - Kama mikakati ipo, ni kwa namna gani elimu ya sayansi ni muhimu katika kupunguza umaskini?

Maswali Mahususi

1. Katika uzoefu wako, nieleze kuhusu ufanisi wa mitihani ya sayansi ya kidato cha nne?
2. Nieleze kuhusu mwelekeo wa ufauru wa wanafunzi katika masomo ya sayansi kwenye shule za serikali?
    - Ni kwa jinsi gani idara yako inashughulika kuwawezesha wanafunzi ili wafanye vizuri zaidi katiaka masomo ya sayansi?
3. Je, katika idara yako ni nyenzo zingine zipi mnatumia kutathmini uwezo wa mwanafunzi kielimu zaidi ya matokeo anayopata katika mitihani wa mwisho?

4. Je, katika idara yako ni vigezo vipi mnatumia kutathmini uwezo wa mwanafunzi anajitahidi kimasomo lakini hafanyi vizuri katika matokeo ya mitihani yake ya mwisho?
    - Ni kwa jinsi gani mtihani wa mwisho unatoa tathmini uelewa wa masomo ya sayansi?
    - Ni kwa jinsi gani mitihani ya mwisho ina tathmini vipaji vya manafunzi, uvumbuzi, na umakinifu?
5. Je, kuna mikakati mingine mnatumia kutathmini uwezo wa mwanfunzi kielimu licha ya mitihani ya mwisho?

Appendix F: IRB Approval

DEPAUL
UNIVERSITY

Office of Research Services
Institutional Review Board
1 East Jackson Boulevard
Chicago, Illinois 60604-2201
312-362-7593
Fax: 312-362-7574

Research Involving Human Subjects

NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

To: Eugenia Wandela, Doctoral Candidate, College of Education

Date: March 14, 2013

Re: Research Protocol # EW020113EDU
"Post-Colonial and Tanzanian Perspectives on Science Education, Pedagogy, and Curriculum: A Qualitative Study"

Please review the following important information about the review of your proposed research activity.

Review Details
This submission is an initial submission.

Your research project meets the criteria for Exempt review under 45 CFR 46.101 under the following category:

> *(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.*

Approval Details
Your research was originally reviewed on February 21, 2013 and revisions were requested. The revisions you submitted on February 25, 2013 were reviewed and approved on March 14, 2013.

Number of approved participants: 9 Total
You should not exceed this total number of subjects without prospectively submitting an amendment to the IRB requesting an increase in subject number.

Funding Source: 1) None

Approved Performance sites: 1) Office of Ministry of Education and Vocational Training (MoEVT); Office of Tanzania Institute of Education (TIE); Office of the National Examination Council of Tanzania (NECTA)

Reminders
- Under DePaul's current institutional policy governing human research, research projects that meet the criteria for an exemption determination may receive administrative review by the Office of Research

Services Research Protections staff. Once projects are determined to be exempt, the researcher is fre to begin the work and is not required to submit an annual update (continuing review). As your projec has been determined to be exempt, your primary obligation moving forward is to resubmit your research materials for review and classification/approval when making changes to the research, but before the changes are implemented in the research. **All changes to the research must be reviewed and approved by the IRB or Office of Research Services staff.** Changes requiring approval include, but are not limited to, changes in the design or focus of the research project, revisions to the information sheet for participants, addition of new measures or instruments, increasing the subject number, and any change to the research that might alter the exemption status (either add additional exemption categories or make the research no longer eligible for an exemption determination).

- **Once the project is complete, you should submit a final closure report to the IRB.**

The Office of Research Services would like to thank you for your efforts and cooperation and wish you the best of luck on your research. If you have any questions, please contact me by telephone (312) 362-6168 or by email at avander1@depaul.edu.

For the Board,

Adam R. Vanderloo, JD
Research Protections Coordinator
Office of Research Services

Cc: Jeffrey Kuzmic, Ph.D., Faculty Sponsor, College of Education
Barbara Rieckhoff, Ph.D., LRB Chair, College of Education

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